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To the solid ground
Of Nature trusts the mind which builds for aye —WORDSWORTH

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REVIEWS AND OUR BOOKSHELF

INDEX TO LITERARY SUPPLEMENT

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

To the solid ground
Of Nature trusts the mind which builds for aye —WORDSWORTH

THURSDAY, NOVEMBER 1, 1906

SOME RECENT WORKS ON LOGIC

(1) *Symbolic Logic and its Applications.* By Hugh MacColl. Pp. xi+141. (London: Longmans, Green and Co., 1906.) Price 4s. 6d. net.

(2) *The Development of Symbolic Logic.* By A. T. Shearman. Pp. xi+242. (London: Williams and Norgate, 1906.) Price 5s. net.

(3) *An Introduction to Logic.* By H. W. B. Joseph. Pp. vii+564. (Oxford: Clarendon Press, 1906.) Price 9s. 6d. net.

(4) *Thought and Things, or Genetic Logic.* By James Mark Baldwin. Vol. i. Functional Logic, or Genetic Theory of Knowledge. Pp. xiv+273. (London: Swan Sonnenschein and Co., Ltd., 1906.) Price 10s. 6d. net.

(1) WHETHER Mr. MacColl is the Athanasius of symbolic logic or only its Ishmael, the fact remains that he seems unable to come to an agreement with other exponents of the subject. But he contends that his system "in the elastic adaptability of its notation bears very much the same relation to other systems (including the ordinary formal logic of our text-books) as algebra bears to arithmetic." The present work contains the results of a series of researches dating from the year 1872. Portions have appeared at intervals in various magazines, English and French. Points on which he lays considerable stress, and in which he does not command the uniform assent of the other symbolic logicians, are these:—(a) that he takes statements and not terms to be in all cases and necessarily the ultimate constituents of symbolic reasoning; (b) that he goes quite beyond the ordinary notation of the symbolists in classifying propositions according to such attributes as true, false, certain, impossible, variable; (c) that in regard to the existential import of propositions, while other symbolists define the null class 0 as containing no members and understand it as contained in every class, real or unreal, he, on the other hand, defines it as consisting of the null or unreal members 0_1, 0_2, 0_3, &c., and considers it to be excluded from every real class. A chapter is devoted to the solution of Prof. Jevons's so-called inverse problem.

(2) The sub-title of Mr. Shearman's work is "A Critical Historical Study of the Logical Calculus," and its author's chief object is to show that during the last fifty years a definite advance has been made by symbolic logic.

"I have traced the growth of the subject," he writes, "from the time when Boole originated his generalisations to the time when Mr. Russell, pursuing for the most part the lines laid down by Peano, showed how to deal with a vastly wider range of problems than Boole ever considered."

He is careful to point out that the view which he expresses in his work as to the relation of mathematics to logic "is to be regarded as preferable only to the doctrines that were in vogue prior to the time of Peano's analysis of mathematical notions."

Mr. Shearman's opinions on some disputed points may be noted:—(a) He can see no valid reason why symbols may not designate now classes and now propositions. The only thing to be remembered is that the rules of procedure are not quite the same in the two cases. (b) He rejects all attempts to deal with any but assertoric propositions, and holds that if Mr. MacColl wishes to work with such data as probable and variable he should introduce new terms. (c) He regards it as practically impossible to elaborate a calculus based on intension.

In a footnote he directs attention to a remark of the late Prof. Adamson which seems to imply that all the intermediate processes in a solution ought to be intelligible. Our author believes, on the other hand, that "a calculus is a means of reaching correct conclusions by means of the mechanical application of a few logical rules, and it is quite possible that in the application of such rules unintelligible elements may temporarily appear." The doctrines of Prof. Jevons and Mr. MacColl are subjected to some severe criticisms, and Mr. Shearman holds that Prof. Jevons's actual contributions to the development of symbolic logic were few and relatively unimportant.

The last chapter contains a warm defence of the utility of symbolic logic, though the author does not claim that it can be used directly by natural science

(3) Mr Joseph's work is on very different lines from the two foregoing It is an excellent and very sound exposition of the traditional logic for which Oxford has been famous ever since the days of Chaucer's Clerk But if the matter is traditional, the manner of exposition is as fresh and independent as it could well be, and the author has entirely fulfilled the desire expressed in his preface not to teach anything to beginners which they should afterwards have merely to unlearn Especially valuable are some of the discussions of particular topics, *e g* of the *principium individuationis* (on p 76), or (on p 275) of the passage from Aristotle's "Categories" which is sometimes quoted as a source of the "Dictum De Omni" We note, too, Mr Joseph's irresistible objections to classificatory division by dichotomy, so zealously defended by Jevons and the others who won our earliest logical sympathies, and his rejection (in excellent company) of the doctrine of the inverse relation of extension and intension

Mr Joseph has interesting remarks to make on the relation between mathematics and logic, and a good statement of the doctrine that the principle of syllogistic inference cannot be made into the premiss of a particular syllogism without begging the question His chapter entitled "The Presuppositions of Inductive Reasoning the Law of Causation," is a model of clear and forcible reasoning Mill's four methods, he finds, may be reduced to one "method of experimental inquiry," which is ultimately based on disjunctive reasoning, and the essence of which is "that you establish a particular hypothesis about the cause of a phenomenon, by showing that, consistently with the nature of the relation of cause and effect, the facts do not permit you to regard it as the effect of anything else"

There is a valuable seven-page discussion (pp 352–8) of the inductive syllogism in Aristotle, whom the author seeks to defend—not without qualifications—from the objection that, after all, his induction rests on complete enumeration, and that thus *deduction* from any premiss so gained becomes a hollow pretence Where the units are species, he points out, and one wants to prove something about the genus to which they belong, complete enumeration is possible and legitimate but where the units are individuals, one does not (according to Aristotle) work by an inductive syllogism that summons all the instances, one learns the essential nature of the species to which they belong by induction, but the induction is now a psychological rather than a logical process, and we arrive at the conclusion, not through an inductive syllogism, but "in virtue of the necessary relation between the two terms which our familiarity with particulars makes possible, but which is the work of intellect or *nous*" We should have welcomed in this connection a detailed exposition of some of the difficulties in the concluding chapter of the Posterior Analytics

(4) This volume is the first instalment of what promises to be an important inquiry, "inductive, psychological, genetic," into the actual movement of the function of knowledge The author distinguishes genetic logic from formal (or the logician's) logic, and metaphysical logic (or logicism), and he describes genetic logic as the physiology and comparative morphology of knowledge—physiology because it examines function, and comparative morphology because "it asks about the relation of the forms and other logical determinations of the several modes of cognitive process to one another, and aims to make out an interpretation of the series of forms as conditioned upon functions"

Prof Baldwin's account of the process by which cognition is built up is so coherent and intricate that it is impossible to give more than a fraction of its substance here He begins with the condition of bare awareness of an object, the a-dualistic consciousness, examines the place of interest as a factor in the determination of the object, and the meaning of various terms like *disposition, autonomic, heteronomic, control, project, reality coefficient*, shows how "it is the stimulation, not the response, that is the controlling factor in the construction of sense objects," and how the first distinction is made in the perception of persons and things Then he passes to image objects and memory objects, and discusses the process by which the inner-outer dualism is reached This leads him to an examination of play or make-believe objects, and then we have three valuable chapters on various aspects of meaning The last two chapters deal with the mind-body dualism and the dualism of subject and object

The terminology of the work is not of the simplest but behind it one finds that the writer has something true and important to say Two other volumes—one on experimental logic and one on real logic—will complete the work, which is being published simultaneously in English and French

A MANUAL OF PHARMACOLOGY

A Manual of Pharmacology By Dr. W E Dixon Pp xii+451, numerous curves, diagrams, and formulæ in the text (London Edward Arnold, 1906) Price 15*s* net

PHARMACOLOGICAL literature in the English language has during the last few years increased considerably, and this is true even if we exclude the copious additions to this literature emanating from America Students of pharmacology at the present time have at least three exhaustive text-books to choose from, all up to date, and written by teachers actively engaged both in teaching and original research In each of these works the classification of the subject adopted is markedly different, from which, perhaps, the philosophical reader would be apt to infer that in the present state of our knowledge, whether of the action of drugs or of the chemical composition of their active ingredients, no absolute classification is possible In the book before us prominence is certainly given in determining classification to the physiological action of the drugs in question, and in the present

state of our knowledge perhaps a classification based upon such principles is the most satisfactory The matter is, however, one of considerable difficulty, as nearly all drugs exert many physiological actions not always differing only in degree, but in some cases actually in kind It is, from the nature of the case, therefore obligatory to take one action of a drug as determining its position in one or other group As an instance we may cite caffeine Dr Dixon places this drug by virtue of its action in the group of diuretics, if we, however, follow the text we find that considerable space is of necessity devoted to the other, almost equally important, actions of this alkaloid

It is difficult in a review of ordinary dimensions to do adequate justice to a work of this character, and in the remarks which follow we shall confine ourselves to a few salient points which strike us as being likely to interest the medical and general scientific reader In the first place, it seems that on account of the entire absence of all reference to original literature the book is not intended to be a book of reference, further, the absence of information with regard to pharmacological technique obviously places the book in the library rather than in the laboratory As the author states clearly in his preface, several of the facts are new, and doubtful statements have been verified by experiments performed in his own laboratory In this connection we must say at once that the reader will have carefully to consider the magnitude of the evidence with regard to these new facts and verifications of doubtful ones The therapeutics included in Dr Dixon's work are only such as to illustrate the pharmacology, from this it clearly follows that the book is not intended for those engaged in the practice of medicine Materia medica is only briefly dealt with, although in many cases very abstruse details and complicated formulæ with regard to the chemical composition of substances, such, for instance, as hydrastine, are given We think such details cannot be of use to the ordinary student of pharmacology, and to be of any value to the pharmacological or chemical worker should be accompanied by a reference to the literature from which they are derived, and here we will observe that although in his preface the author mentions a list of standard works dealing with pharmacology and materia medica to which he is indebted, all reference, so far as we can find, to books dealing with the question of the chemical composition and reactions of, for instance, the alkaloids and their derivatives is omitted

The first thirty-eight pages of the book are devoted to general considerations, amongst which perhaps the most attractive is a discussion of the relation between physiological action and chemical constitution This interesting subject is treated at some length, and most of the important facts bearing upon it are carefully considered Under the heading of the standardisation of drugs, the author discusses the question of physiological standardisation He rightly directs attention to the extreme difficulty of standardising certain preparations according to their chemical content, and we entirely agree that, in the case of certain drugs, standardisation of a physiological type should be adopted, that is, different preparations should be compared with regard to their action upon a constant tissue unit Such a method has been successfully adopted, under even more complicated conditions, in the comparison of the relative toxicity of certain sera We must confess, however, that we are in this connection somewhat surprised to read that the cardiac glucosides can be standardised by perfusing the isolated rabbit's heart with Ringer's solution and subsequently adding the drug The author must either be under some misconception with regard to the composition of Ringer's solution or be in possession of important facts which, so far as we are aware, he has not published

From chapter iii on, the book is devoted to descriptions of the characters, preparations, and physiological actions of the official, and some important unofficial, remedies and drugs The action of each drug is most exhaustively considered, and in most cases illustrated by one or more curves, the result in the vast majority of cases of the author's own experimentation The amount of space devoted to these curves is certainly a feature of the work, and renders to it, at least from one point of view, a unique value, as, however, usually no discussion of the conditions of the experiment accompanies the curves, the reader has too often to take upon trust the conclusions based upon them

The mass of the pharmacology of the more purely inorganic substances is prefaced by a short but complete discussion of salt action and some of the chief bearings of modern physical chemistry upon pharmacological action

The final chapter of the book is devoted to ferments vegetable toxins, internal secretions, serum-therapy, and antagonism The work concludes with an exhaustive index

Dr Dixon's "Manual" is certainly an important addition to standard pharmacological literature, and if in our opinion its educational value, taken as a whole, is less than that of certain of its contemporaries, this is to some extent due to the curious position its subject matter holds in the complicated medical education of to-day We have no hesitation in saying that it should be possessed by every pharmacologist and pharmacological laboratory, if only as containing a number of original experimental results worthy of control and further investigation

A PIONEER IN BIOLOGY

Jan Ingen-Housz Sein Leben und sein Wirken als Naturforscher und Arzt By Prof Julius Wiesner Unter Mitwirkung von Prof Dr Th Escherich, Prof E Mach, Prof R von Toply, und Prof Wegscheider Pp x+252 (Vienna C Konegen, 1905)

DR WIESNER relates that on his becoming professor of plant physiology in the University of Vienna, more than thirty years ago he resolved to become familiar with the work of the founders of that science Soon he became peculiarly interested in

the labours of Ingen-Housz, and found that his real worth had not been recognised Much information was gathered that showed how many-sided his activities had been in science and in medicine, and Prof Wiesner was induced by the meeting of the International Botanical Congress at Vienna to present the results of his labour of love in this volume It must rank as a classic, admirable as a biography of a leader in research and as a history of scientific progress in a most important field of study

Jan Ingen-Housz was born at Breda, in Brabant, South Holland, on December 8, 1730, and attended the higher school there until the age of sixteen, after which he continued his education in the Universities of Louvain, Leyden, Paris, and Edinburgh, even after he had graduated (at the age of twenty-two) in Louvain From 1757 to 1765 he practised medicine in Breda, but after the death of his father, he went to London, on the invitation of Sir John Pringle, the King's physician Here he became acquainted with distinguished anatomists and medical men, and made a study of the method of inoculation for small pox From London he went to Vienna, by the wish of the Empress Maria Theresa and introduced the use of inoculation there

He frequently visited Switzerland, France Holland, and England For the last country he had an especial affection, regarding it as the land in which science was most honoured and furthered He died in 1799, near London, while on a visit to the Marquis of Lansdowne

Ingen-Housz approached the research which has brought him most fame -the relation of plants to the atmosphere—from the standpoints of the physicist and chemist rather than the botanist, and with a view to the value of green plants exposed to daylight as purifiers of the atmosphere from the products of animal respiration He had busied himself with the physical problems of electricity, magnetism, optics, and heat and had made useful contributions to their investigation His researches in chemistry led to improvements in the preparation of matches and in other matters of practical value

A very valuable advance in microscopical technique introduced by him was the use of a cover over the drops of water or other fluids in which the objects were included for examination At first the covers were made of mica, but soon he employed thin glass covers, as is now the custom

His researches into the nutrition of plants were for the most part carried on during his stay in Vienna, although his first work on the subject was published in London in 1779 under the title "Experiments upon Vegetables, discovering their great Power of Purifying the Common Air in the Sunshine and of Injuring in the Shade and at Night" It was soon issued in German and Dutch translations

When Ingen-Housz began the researches that led him to such great results it was generally taught that plants extracted from the soil the materials of which they were in want in the conditions in which they exist in the plant, and that nothing of importance required to, or did, pass off from plants That gas was given off had been determined by Priestley and by Scheele, who had investigated the relations of green plants with the atmosphere, but Priestley arrived at the conclusion that these plants always freed the atmosphere from the "fixed air" (carbon dioxide) emitted by animals and emitted "dephlogisticated air" (oxygen), and Scheele believed that they always added to the amount of the "fixed air"

Ingen-Housz succeeded in showing that both these eminent chemists were right in part, the green parts in daylight emitting "dephlogisticated air," while parts not green at all times, and even green parts in darkness, like animals, emitted "fixed air" His views were combated, even Priestley joining in attacking them, and by his authority preventing their importance from being recognised as it deserved to be.

The new foundation for chemical investigation afforded by Lavoisier's discoveries was made use of by Ingen-Housz to explain more fully the nutrition of green plants than had been possible until the recognition of the composition of the "dephlogisticated air" and the "fixed air," and he showed that the carbon contained in plants is derived from the carbon dioxide of the atmosphere instead of from the soil as had been supposed by Senebier He also showed that the carbon could be acquired by green plants only in light, and that carbon dioxide beyond a limited degree of concentration in the atmosphere proved harmful even to plants as well as to animals He thus distinguished between the respiration and the assimilation in plants, a distinction not fully realised or taught by botanists until many years later The value of humus and of vegetable manure as food for plants he ascribed, not to the substance being directly employed by the plants as food, but to its effect on the mineral contents of the soil, which were rendered more easy of absorption, and he demonstrated that diluted mineral acids produced similar beneficial effects His later views on the nutrition of plants are given in "An Essay on the Food of Plants and the Renovation of Soils," which is contained in a collection of essays (in which it is No 3) issued under the title "Additional Appendix to the Outlines of the Fifteenth Chapter of the Proposed General Report from the Board of Agriculture on the Subjects of Manures," London, 1796

An appendix stating the sources of information about Ingen-Housz, with extracts from letters and a bibliography of his writings, adds to the value of the volume and supports Prof Wiesner's claim that he must be classed among the founders of botany, and that he showed singular ability also as an investigator in physics and in medicine

ANALYSIS OF PAINTS

The Chemistry of Paints and Paint Vehicles By Clare H Hall Pp vi+134 (London Constable and Co, Ltd, 1906) Price 8s net

THIS book or booklet is not intended to appeal to the artist the house painter or the manufacturer, but to the young analyst who has had little or no experimental acquaintance with the materials discussed in its pages The scope of the volume is indeed extremely limited, since it deals with the ex-

combination of only a few common pigments, and by no means exhaustively even with these, about some vehicles and diluents the information to be found in these pages is less meagre.

There are five chapters in this book, an appendix containing thirteen tables, and an adequate index. Chapter i. is devoted to the determination of certain constituents of common paints, and deals with aluminium, barium, carbon dioxide, chromium, iron, lead, magnesium, manganese, silicon, sulphur, and zinc. In this chapter, which occupies only fourteen pages, we are struck with the inadequate, and even puerile, drawing of the CO_2 apparatus shown in the figure on p. 3, and with the confused nomenclature of the two oxides of chromium. For example, on pp. 4 and 5 we are told that "all chromate compounds must be changed into the chromic state, which is indicated by an intense green color," and that this "green color is due to chromic salts." The omission of any caution as to the non-volatile impurities commonly occurring in the hydrofluoric solution used in ascertaining the purity of silica is unfortunate.

The properties of a few common pigments, such as Prussian blue, ultramarine, ivory-black, umber, Vandyke brown, the mixture of lead chromate and Prussian blue wrongly called chrome green, iron-red, genuine and imitative vermilion, a number of white pigments or adulterants, chrome yellow, red lead, yellow ochre, and the siennas are dealt with. This list serves to show how many of the finer and choicer pigments, namely, aureolin, cadmium yellow, viridian, and cobalt-blue, are excluded from consideration. Nor can we agree with everything we find in these pages. Ivory- and bone-black are not "*combinations* of carbon, hydrocarbons, water and mineral matter." Graphite does not possess a "*brownish* gray" colour, and there are many words wrongly spelt in this chapter, such as analine for aniline, and limonite for limonite.

The examination of actual paints, and of such as are mixed ready for use, is dealt with in the third chapter. The preliminary treatment of oil paints necessary before they can be tested or analysed is duly described. Chapter iv. is concerned with the matching of samples, while the final chapter is devoted to vehicles. Here will be found a more adequate, detailed treatment of the subject. On pp. 89–92, for instance, the curious drying oil called Chinese wood oil is described. This oil is used largely both in China and Japan, and is imported into America and Europe in increasing quantities. It is obtained from the seeds of *Aleurites Fordii* (Hemsley) and of other species of the same genus, as *A. cordata* and *A. trisperma*. Mr. C. H. Hall states (*loc. cit.*) that this oil, if heated to 285° C. to 300° C., suddenly solidifies into a jelly which is no longer soluble in the usual solvents, and cannot be reduced again to the liquid state. Mr. Hall's statement that Chinese wood oil, even in small proportion, confers upon paints the property of drying without gloss, and may be used as a substitute for wax in painting media intended to produce a dull or matt surface, seems to merit particular attention.

The thirteen tables of constants, coefficients, and specific gravities which constitute the appendix to this volume will be found useful by the analyst. There is a full index.

This little book, with all its imperfections and its immaturity, is not destitute of merit.

OUR BOOK SHELF

British Rainfall, 1905. (Forty-fifth annual volume.) By Dr. Hugh Robert Mill. Pp. 271. (London: Edward Stanford, 1906.) Price 10s.

THE forty-fifth issue of this annual volume tells us better than any mere description could do of the healthy and active state of this voluntary rainfall organisation. When it is considered that more than 4000 individuals scattered over the British Isles read their rain-gauges at 9 o'clock every morning, enter their results on a form, and send in monthly returns to the central bureau at 62 Camden Square, and do all this voluntarily, it is impossible not to admire this band of enthusiasts for their united efforts in so good a cause.

The valuable collection of rainfall statistics is not, however, allowed to lie idle, for the energetic head of this organisation, Dr. H. R. Mill, with his small staff, brings all the facts together and discusses the distribution of this rainfall both in space and time.

The present volume shows how well this work is carried out, and the observers must feel a great amount of satisfaction in seeing their united efforts so ably handled. Fronting p. 64 is a map indicating the positions of the 4006 rain-gauges at present in use, and one can see at a glance the districts where observers are urgently needed. Ireland and north and central Scotland are conspicuously in need of more volunteers, and it is hoped that many of the places mentioned in the text will soon be counted among the recording stations.

As meteorological readers of NATURE are fully acquainted with the general arrangement of the matter in these annual volumes, it is only necessary in this notice to direct attention to some of the discussions on the collected statistics. Thus, after a brief review of the recent important publication on the "Precipitation in the North German River Basins," compiled by Prof. Hellmann, we are presented with some valuable data on the relation of evaporation from a water surface to other meteorological phenomena. The section on heavy falls on rainfall days in 1905 will be found very interesting reading, and the numerous maps show at a glance the distribution of these falls over the country. After sections dealing with the distribution of rainfall in time and a discussion of monthly rainfall, we come to the relation of the total fall of rain in 1905 to the average. To sum up in a few words the result of this discussion, it may be said that for the whole of England and Wales the general rainfall for 1905 was 16 per cent. below the average. In fact, so low was this figure that "except for 1902 and 1893 there has not been so dry a year in England since the memorable drought of 1887." It will be interesting to see how the present year's rainfall statistics compare with those of 1905. In 1905 Scotland as a whole had a deficiency of 5 per cent., while Ireland suffered to the extent of 12 per cent.

In addition to a great number of tables, the text is well supplied with numerous suitable maps and illustrations, making the volume a valuable summary of British rainfall for the past year.

W. J. S. L.

Technical Thermometry Pp ix+62 (Cambridge The Cambridge Scientific Instrument Co Ltd 1906)

This pamphlet contains detailed illustrated descriptions of the various types of instruments for temperature measurement made or sold by the Cambridge Scientific Instrument Co which has long been in the front rank in the manufacture of electric thermometers of all kinds

It deals first with the well known platinum resistance thermometers of the Callendar Griffiths type These are made in many different forms Among the most interesting of the apparatus used in connection with them is the ingenious direct reading temperature indicator which gives without any calculation the direct centigrade or Fahrenheit temperature on the air scale with a sensitiveness of considerably less than 1° up to 1 00° C The various types of resistance boxes used in accurate platinum thermometry are all arranged to be capable of self verification We believe that this self testing type of resistance box was among the first examples of a high-class physical instrument intentionally arranged by the makers to encourage periodical standardisation by the user rather than complete dependence upon the original adjustment The Callendar recorders in their various forms can now be made to give with very low energy consumption continuous records of resistance temperature radiation E M F current or power within very wide limits

Among the thermoelectric appliances is a new form of recording millivoltmeter in which the galvanometer boom is depressed every half minute on to an inked thread thereby leaving a dotted record on the paper The instrument can be made sufficiently sensitive for recalescence curves The radiation pyrometers of Prof Féry are also described and illustrated In these the radiation from the object the temperature of which is to be measured is concentrated upon a minute thermocouple at the focus of a mirror or lens and the E M F set up is measured in the ordinary way by a suitable millivoltmeter

In an appendix are given an excellent summary of the principles of electric thermometry with tables of constants and a list of trustworthy melting and boiling points obtained from the National Physical Laboratory also a good bibliography of recent thermal research

Astronomischer Jahresbericht Band vii Literature of 1905 By A Berberich Pp xxxviii+646 (Berlin Georg Reimer 1906) Price 20 marks

This volume is the seventh issue of a series of most useful compilations and it is a matter of deep regret that the founder and chief worker of such an admirable publication is no longer with us Herr Walter Friedrich Wislicenus died last year on October 3 but as we are told by Dr Walter de Gruyter in a brief obituary notice he contributed a considerable portion of the present volume The frontispiece to this issue therefore fittingly presents us with an excellent portrait of the founder whose place is now taken by Herr A Berberich

With regard to the book itself little need be said except that the high standard of former years has been maintained The 600 pages of references with their brief and concise abstracts cover the domain of astronomical literature for the past year and a very complete name index concludes the volume It may be incidentally remarked that the total solar eclipse of August 1905 is responsible for no less than ninety five references, which help somewhat to increase the bulk of the present volume

Zoologischer Jahresbericht für 1905 Herausgegeben von der Zoologischen Station zu Neapel Redigirt von Prof Paul Mayer (Berlin R Friedländer und Sohn 1906) Price 24 marks

The always welcome Naples Jahresbericht" appears as usual well up to time and its familiar features remain unchanged Purely taxonomic papers are not included in the programme but this limitation has been generously interpreted by some of the recorders Where we have been able to test the lists we have found them full and accurate and many of the summaries are models of terseness and clearness If we look at the first section we are at once struck with the rapidly increasing number of important researches on the Protozoa if we look at the last section we are similarly impressed with the number of papers dealing with Mendelian phenomena The indefatigable editor Dr Paul Mayer is responsible for the reports on Protozoa Bryozoa Brachiopoda on part of the Arthropoda and on general biology—truly a heavy piece of work for a man who does so much else To him and to his *collaborateurs* we offer in the name of zoologists our hearty thanks

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return or to correspond with the writers of rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Absorption of the Radio active Emanations by Charcoal

PROF RUTHERFORD in his interesting letter in NATURE of October 25 (vol lxxiv p 634) on the Absorption of the Radio-active Emanations by Charcoal has no doubt quite unintentionally mistaken the general results of my experiments and therefore I feel that some slight addition ought to be made to his communication

In the first paragraph of his letter Prof Rutherford says that the interesting property of certain kinds of charcoal notably that of the cocoa nut of rapidly absorbing gases *except the inert gases belonging to the argon family* is now well known since the recent experiments of Sir James Dewar

Now the statement made in the part of the paragraph I have italicised is not accurate In my papers entitled The Absorption and Thermal Evolution of Gases Occluded in Charcoal (Proc Roy Soc 1904) The Separation of the more Volatile Gases from Air without Liquefaction (Proc Roy Soc 1904) Nouvelles Recherches sur la Liquefaction de l Helium (*Comptes rendus* 1904) and New Low Temperature Phenomena' (Proc Roy Inst 1905) I have shown that all the inert gases without exception can be condensed in charcoal as effectively as ordinary gases provided corresponding conditions of temperature pressure and concentration are maintained

In speaking of the many avenues for future inquiry opened up by the charcoal method of separating gases I said (Proc Roy Soc p 130 1904) — The method I have described will be equally applicable to the treatment of the gaseous products from minerals containing helium hydrogen &c and also to the radium products of the same kind It seems even probable that the separation of the less volatile constituents in the air may be improved by a slight modification in the mode of working As a matter of fact at the time of these communications to the Royal Society in 1904 I had made a few experiments on the condensation of the radium emanation by charcoal *in vacuo* and also on the separation of krypton and xenon but during the last two years my health has been so indifferent that many lines of investigation have had to be abandoned In my Royal Institution lecture of June 6 1905 I ex-

plained and exhibited the process of separating krypton and xenon, showing that a proportion of less than a millionth of these constituents in the atmosphere can be condensed and concentrated in charcoal cooled to the temperature of liquid air Turning again to Prof Rutherford's letter, his surprise about the absorption of the emanation of radium thorium, and actinium by charcoal on the ground of being inert gases may be dismissed as nothing more than what we should anticipate but the temperature at which the absorption by charcoal takes place raises some important questions

To take an illustration (Proc Roy Inst 1905) I have shown that charcoal cooled in solid carbonic acid at the temperature of 195° ab is capable for a time of absorbing the carbonic acid present in air (amounting to, say 3/1000 of an atmosphere) until the concentration rises to about 1 per cent of the weight of the charcoal If on the other hand the separation of the carbonic acid from the air had to be done by cooling alone then the temperature of the air must be reduced below 129° ab and about 100° ab it would for practical purposes be nearly all removed Thus charcoal about twice the absolute temperature required for condensation by mere cooling is for a small concentration of the gas undergoing absorption equally effective We can compare now the behaviour of the radium emanation with that of carbonic acid In the paper of Rutherford and Soddy on the condensation of radio active emanation (*Phil Mag* 1903) it is shown that the temperature has to be lowered below 138° ab in order to condense the radium emanation while it is complete by 123° ab By analogy therefore we anticipate that at twice 138° ab charcoal would still act as a condensating agent This then brings us up to about the ordinary temperature just what Rutherford has found to be sufficient Such comparisons however may not necessarily mean that the radium emanation is comparable in volatility with carbonic acid at low temperatures

The results of Rutherford and Soddy would seem to show that the radium emanation has a high latent heat of volatility and consequently by all analogy a high boiling point Thus they say (*Phil Mag* 1903) that the radium emanation begins to volatilise at 118° ab and by 119°5 ab the amount is increased four times If we accept the view that the partial pressures of the emanation were in the ratio of one to four at the two temperatures given above then we may apply the Rankin formula ($\log P = A - B/T$ where A and B are constants P the pressure and T the absolute temperature) and find the order of the value of the B which is proportional to the molecular latent heat which in this case comes out 5662 Taking again the relative electrometer leaks by the statical method of 5 3 at 126°5 ab and 0 74 at 124°5 ab this gives 6735 which is of the same order of magnitude The following values of the B constant for different bodies are useful for comparison —

	B constant
Sulphur (solid)	4599
Mercury (liquid)	3170
Phosphorus (liquid)	2570
Carbonic acid (solid)	1353
Argon (liquid)	339
Xenon (liquid)	669

The calculated value of the B constant of the radium emanation is then twice the value for mercury and nine times the value for xenon We need not press however the accuracy of the latent heat constant of the radium emanation too far so let us divide it by two which will make it of the order of the latent heat of mercury or phosphorus Accepting for the moment such a value of the molecular latent heat we cannot avoid inferring that the boiling point of the emanation may be relatively higher than one at first might anticipate Even if we assume that the emanation represents a gas two steps higher in the periodic series than xenon the B constant would by analogy be only a little more than 1000 The latent heat argument supports the view that the molecular weight of the emanation must also be high and of the order of 200 or above It Naturally the theoretical argument based on the value of the latent heat constant fails if it is not legitimate to use the electrometer measurements of Rutherford and Soddy as being equivalent to the ratios of the partial pressures of the radium emanation JAMES DEWAR

Royal Institution October 29

Radium and Geology

FULLER consideration of the experimental evidence on the effects of concentration on the activity of radium convinces me that, on the whole this is certainly against the *a priori* probable assumption that a large part of the activity is not spontaneous I refer more especially to Prof Rutherford's experiment on dilution as touched on in my letter in NATURE of October 25 Other considerations lead to the same view

The conclusion at issue is, however too important to be left on the existing experimental basis J JOLY

Geological Laboratory Trinity College Dublin

The Evolution of the Colorado Spiderwort

UNTIL recently the name *Tradescantia virginiana* of Linnæus was made to include a multitude of forms without discrimination However as we go from east to west we observe a marked change in the spiderworts corresponding with an equally marked change in climate The more eastern forms of moist regions are tall and rank with bright green foliage The true *virginiana* has the pedicels and sepals villous the hairs not glandular and does not in any way suggest a xerophyte In the middle west are two forms *T occidentalis* (Britton) bright green but with narrow leaves and usually smaller flowers the pedicels and sepals with gland tipped hairs and *T reflexa* Raf glaucous the pedicels glabrous the sepals with a tuft of hairs at the apex The latter is more especially southern and is said to extend even to Florida Still further west we find in New Mexico another form *T scopulorum* of Rose slender and much branched glaucous with glabrous pedicels and smooth sepals Still again we have in Colorado a distinct plant which I have named *T universitatis*[1] This is strongly glaucous robust but not very tall pedicels glabrous with a very few gland hairs sepals glandular pilose The leaves are broad (the sheathing bases 12 mm to 13 mm wide) and the flowers are about 35 mm across There is no sign of any tuft of hairs at the apex of the sepals

In all this we have a series of changes not always simultaneous from bright green to glaucous and from simply villous pubescence to gland tipped hairs In some cases the leaves become narrower and the flowers smaller It is easy to see in all this direct adaptation to drier conditions[2] but it is not so easy to determine how it came about or how far it may result from immediate influences modifying individuals of a plastic type At Boulder Colorado the *T universitatis* is a plant of spring and early summer and has the characters just referred to This year however a ditch was dug right through a place where the plants abounded and many of them were covered up by the earth thrown out To day September 30 I find that these plants have managed to sprout through the covering soil and are now in full bloom They are typical except in one conspicuous character—the pedicels and sepals both are profusely gland hairy If one received these specimens with the mere statement that they were gathered on the last day of September noticing the profuse pilosity as well as the unusual time of flowering one would readily take them for a distinct thing

There seems to be some confusion about the plant originally named *occidentalis* by Britton As first described it was said to have narrowly linear leaves and the first locality cited was Wisconsin Rydberg in his recent Flora of Colorado" gives it a quite different range no further east than Nebraska and makes it include the Colorado plants The name must go however with the plant originally described T D A COCKERELL

University of Colorado Boulder Colorado

September 30

1 Type locality the Campus of the University of Colorado at Boulder Also common on the Campus of Colorado College at Colorado Springs

2 And in part more saline soil?

THE DYNAMICS OF BOWLING.[1]

FOLLOWING up their interesting volume on "Great Batsmen," the accomplished authors of "Great Bowlers and Fielders" have practically completed all that action photography can teach us regarding the methods of great cricketers. The present handsome volume, with its 464 action photographs, registers for all time the successive positions of the body in the act of bowling of some of the most celebrated bowlers of our day, and also certain very characteristic attitudes of a number of our best fielders. From the purely cricketing point of view the book must ever be of the most enthralling interest, not because it establishes any fundamentally new principle in the art of high-class bowling, but because it proves the wonderful variety of method by which different individual bowlers effect practically the same result. The movements of the body, arm, wrist, hand, and fingers are all coordinated to the one end of imparting to the ball a definite combination of translation and spin. It does not always happen that the bowler hits off the exact combination aimed at, but when he does the future progress of the ball through quiet air and off a good pitch is absolutely definite. There is no difficulty in understanding the dynamics of the break; the problem is simply that of a rotating sphere impinging obliquely on a rough surface, and is familiar to every one who has handled a billiard cue with intelligence. The point of interest to the would-be bowler is how it is effected. This is discussed at considerable length in distinct parts of the book contributed by Messrs. F. R. Spofforth, B. J. T. Bosanquet, and R. O. Schwarz. The introductory chapter by the "Demon Bowler" (to whom the book is dedicated) is capital reading. It is indeed rather to be studied than read, and the same remark applies to Mr. Bosanquet's lucid and scientific discussion of the off-breaking leg-break.

FIG. 1.—W. Rhodes at the beginning of his final swing. From "Great Bowlers and Fielders."

At the very outset it is obvious that no bowler can give to a cricket ball anything like the combined velocity and spin which can be so easily communicated to a golf ball or even to a tennis ball. The comparative lightness of the latter enables the player to give it sufficient spin (with velocity) so as to call into action the differential air pressure producing evident swerve. Tait in his discussion of the golf-ball flight showed that this swerving force (which acts at right angles to the plane containing the velocity and the axis of spin) may be taken as being proportional to the product of the translational and angular speeds. He estimated that it might attain a value equal to about four times the weight of the ball. In the case of the cricket ball it is doubtful if the deviating force due to air pressures acting on the progressing and rotating ball could ever become more than a small fraction of the weight. Then as the rotation takes place in all over-hand delivery about an axis which makes at the most a small angle with the horizontal, it is clear that there is very little chance of a cricket ball *beginning* its swerve to right or left for the same reason that a golf ball is sliced or pulled. How, then, is the swerve to be explained? The matter crops up at intervals throughout the book, and is discussed at some length by Mr. Spofforth; but with all due regard to his authority as one of the greatest bowlers of all time, it is difficult to accept his explanation as in every respect sound. He says that "a ball which has check spin (that is, under spin) on it loses it through friction against the air during its flight; at the moment this occurs the ball slips the cushion of air it has made, especially in between the seams. What leads me to this belief is that it is almost impossible to swerve unless the seam of the ball is up and down. The check spin keeps the seam vertical until the air-resistance causes the spin to cease altogether. At this point, especially if the ball has an upward tendency and the earth's power of attraction is asserting itself, the swerve will be great. To swerve the ball must have some spin on it, but not much. If it has great spin it will never lose it in time to swerve, and I maintain that at the actual time of swerving the ball has ceased to spin, or nearly so." Further on he says that he has "never seen any bowler swerve with the wind," that "a bowler swerves more while the ball is new," that he does

[1] "Great Bowlers and Fielders: Their Methods at a Glance." By G. W. Beldam and C. B. Fry. Pp. xv+547; illustrated. (Macmillan and Co., Ltd., 1906.) Price 21s. net.

not believe 'anyone (bowling as is usual twenty one yards or less) can get the swerve unless he over pitches the ball." The facts seem to be that for right or left swerving it is essential to have a cross wind blowing, a long pitched ball, and some initial spin with the seam vertical, but not too much of it. It is difficult to believe that the air's resistance can effectually destroy this spin, seeing that the air has apparently very little effect in cutting down the spin which ultimately produces the break. The very fact

FIG. 2.—J. Tunnicliffe securing a one handed catch high up in the slips. From "Great Bowlers and Fielders."

that the ball is projected with a smaller spin to begin with will mean less effective frictional moment acting on the ball. Stokes in fact agreed with Tait that the frictional decay of spin in the case of a golf ball might be neglected to a first approximation, and we may assume the same for a cricket ball.

There is not the least doubt that spin with the seam vertical must produce vertical swerve, to some extent a downward or upward force acting on the ball in addition to gravity according as there is under spin or over spin. Probably most bowlers have an average amount of spin which they put on the ball. This will give what the batsman regards as the normally pitched ball of that bowler. Suppose this normal spin to be over spin. Then it is clear that if the bowler diminishes the over spin or gives an under spin the pitch (*other things being equal*) will be lengthened, but if the over spin is increased the pitch will be shortened. Again, if the normal spin is under spin, a diminution of that will make the ball appear to drop shorter than the expected normal pitch. This is obviously one way of varying the pitch, and one which must be very deceptive to the batsman. This way of stating it might seem at first sight to be inconsistent with Spofforth's remark that "the vertical spin, unlike others, must have excessive check spin, which naturally impedes the flight of the ball from the start and keeps it back from its true destination." It is difficult to see how check spin can keep the ball back from the start. So far as motion through the air is concerned there will be just as much retardation with the over spin rotation as with the under spin rotation. The word "check spin" is in fact unfortunate, suggesting that it not only checks the progress of the ball after it strikes the ground, and that is the origin of the name, but also that it checks the ball as it moves through the air. In all probability the bowler when putting on excessive check spin projects the ball with a somewhat smaller velocity than the motion of the arm would imply. The hand in fact must get ahead of the ball, as is very clearly indicated in one of the photographs of R. O. Schwarz. With a pronounced under spin a smaller velocity of projection is needed for a given length of pitch than when there is no spin, and the velocity of projection is less than what the motion of the arm would suggest. Hence the feeling of a retarded ball both to the bowler and the batsman. The direct effects of varying spins upon the trajectory as described above are true only when other conditions are the same, such as the velocity of projection and the height of the point of projection; but in giving different amounts of spin to a ball it is evident that these other conditions can not be always the same. The conditions of the problem are indeed difficult to state, and one great merit of Mr. Beldam's action photographs is that they throw so much light on the way in which the ball leaves the hand.

But the outstanding difficulty is to explain the right or left swerve, and the action photographs give little

help here The main fact is that all swervers project the ball with the seam as nearly as possible in a vertical plane In the grip the fingers do not touch the seam, although in some cases the thumb does But evidently there is little purchase on the ball, which is projected with comparatively little spin If cross wind is not absolutely essential it certainly greatly facilitates the swerve With some bowlers the swerve is evident from the start, with others it begins to appear only during the latter half of the trajectory The seam is really a roughened zone on which the air may be supposed to exert a greater frictional force than on the other parts of the ball, especially if the ball be new With seam vertical and a cross wind blowing, certain definite dynamical effects will follow One of these will be a tilting of the axis of rotation, a tilting which will, however, take place very slowly when the spin is excessive This suggests the question does the seam remain vertical throughout the flight of a swerving ball? The point might be settled by bowling a swerving ball against a blackened surface and finding which part of the ball first came in contact with the surface That, however, is outside the purpose of the volume

The questions of swerve and break have much scientific interest, but they cover only a part of the whole, and from a cricketing point of view much might be said, not only as to the excellence of the pictures, but as to the instruction conveyed by them and by the accompanying letterpress Mr Beldam has aimed at getting a succession of positions of each bowler, from the beginning of the final stride before delivery to the follow through after the ball is delivered In a few cases the series begins even sooner Where so much is excellent and characteristic it is difficult to choose but here we have reproduced two pictures which will show to what a high degree of perfection Mr Beldam has carried his photographic art The one represents W Rhodes at the beginning of his final swing and is chosen partly because of the perfection with which the grip of the ball is indicated The other is taken from the last quarter of the book, which treats of fielders and is a remarkably fine picture of J Tunnicliffe securing a "wide, high up right handed catch in the slips" This is one of a series showing Tunnicliffe bringing off difficult catches in most extraordinary attitudes

Like its predecessor, "Great Batsmen" this volume is a treasure-house of portraits of many of the most conspicuous cricketers of to-day It is further beautified by a good coloured reproduction of the portrait of F R Spofforth painted by H S Tuke, A R A

C G K

THE POSITION OF AGATHOCLES DURING THE ECLIPSE OF B C 310 AUGUST 15

ON B C 310 August 14 Agathocles left Syracuse by sea, at eight o'clock on the following morning he saw a total eclipse of the sun His exact position is therefore of extreme interest to astronomers Unfortunately, the course that Agathocles steered is not directly stated The present paper is an attempt to piece together the various clues contained in the narratives

We may first briefly glimpse at the way in which Airy handled this question (Phil Trans, 1853, p 188) It appears that on August 20, after a six days' voyage, Agathocles landed in Africa at a place that Airy identifies with Alhowareah Supposing that he went direct, the distance travelled in six days would be 200 miles, if he went round Sicily the distance would be 330 miles Airy therefore marks off on a map thirty-three miles in a southerly direction and fifty-five miles in a northerly direction. He labels these positions as the "possible southern position", and "possible northern position," and he states in the text that the northern position is the more probable, partly because the distance is greater, and partly because the provision ships mentioned in the narrative probably came from Gela in the south

To us, however, it appears totally incredible that Agathocles, after running from a superior enemy for twenty-four hours or thereabouts, should have been within fifty-five miles of his starting point We will now proceed with our own attempt to reconstruct the situation

The first point is that Agathocles started early in the morning, and to that extent had the more time in which to get to a distance from Syracuse This is proved by an expression in the narrative of Diodorus —"After six days and an equal number of nights, as dawn appeared" (ἓξ δ' ἡμέρας καὶ τὰς ἴσας νύκτας αὐτῶν πλευσάντων, ὑποφαινούσης τῆς ἕω) We have no wish to strain this expression to imply that he started at the exact instant of dawn on August 14 It clearly, however, implies that Agathocles was at sea for so great a part of August 14 as to render the phrase "six days and an equal number of nights" more exact than "five days and six nights"

Our second point is that Agathocles had a fair wind We prove this as follows —The Carthaginian fleet was blockading Syracuse, when some provision ships appeared in the neighbourhood The Carthaginians went to attack the provision ships, Agathocles escaped from Syracuse, the Carthaginians left the provision ships and pursued Agathocles, the provision ships then entered Syracuse It must be remembered that warships could be rowed, and that merchant vessels could only sail, and also that so late as the time of Nelson the power of beating to windward practically did not exist The mere fact that the provision ships entered Syracuse therefore establishes the fact that the wind was favourable, both for the provision ships approaching Syracuse and for Agathocles flying from Syracuse, but other considerations will prove the same point The Carthaginians, by leaving the provision ships when they had all but seized them (πλησίον ἤδη τῶν φορτηγῶν ὄντες), clearly had no intention of letting Agathocles escape Before going to attack, the provision ships they probably argued that the occasion would find Agathocles utterly unprepared, and that by the time he had put his men and stores on board they would themselves be back again Now a stern chase is proverbially a long chase (and, moreover, would have taken them out of sight of Syracuse), and the Carthaginians could not have entertained hopes of getting back in time unless the provision ships lay to windward of them Even as it was, Agathocles was ready for his opportunity His men, we are expressly told, had been on board for some days (πληρώσας ἑξήκοντα ναῦς ἐπετήρει καιρὸν οἰκεῖον πρὸς τὸν ἔκπλουν), and he got to sea at exactly the right moment, that is to say, when the Carthaginians had all but reached the provision ships

Agathocles therefore had a fair wind, and to that extent it is the more probable that he was at a considerable distance from Syracuse by the next morning

Two minor points may here be noticed, though they are not essential to our main case When the sixth day dawned Agathocles found himself in the vicinity of a Carthaginian fleet, not necessarily the same one. He rowed hard towards shore, and by virtue of a long start arrived first, although the Carthaginians were rapidly gaining on him, being more accustomed to rowing than the Syracusans (Justin) Possibly,

therefore, Agathocles owed his escape on August 14 to the fact that he could sail instead of row If so, his minimum pace would be seven knots, or otherwise he would have rowed, and the Carthaginians would perhaps have caught him Again, we are ourselves convinced that Agathocles was expecting the appearance of the provision ships It may be that he was merely prepared for any favourable opportunity, but there is much to prove that he laid his plans very carefully He had, for instance, put saddles and bridles on board He could not take horses with him, but he was prepared to use any he might capture on landing On a subsequent occasion, thinking that the appearance of owls (as birds of good omen) would encourage his soldiers, he set some free, which he had evidently provided beforehand (Grote)

We have therefore established that by 8 a m on August 15 Agathocles had been at sea upwards of twenty-four hours, and that he started with a fair wind He clearly did not stand out to sea more than was necessary, for to do so would be to abandon part of his start The last and most important question is, therefore, did Agathocles go north or south?

Our third point is that Agathocles went north Airy has already noted that the provision ships probably came from Gela, on the south coast of Sicily, since that was the only place still, after the battle of Himera two months previously, friendly to Agathocles (Grote) Airy also notes that even 330 miles is a short voyage for six days, and therefore that the longer course is more probable Airy also makes a third point "It is stated by Diodorus that the troops before sailing supposed that they were to make an attack either on Italy or on the Carthaginian part of Sicily, and by Justin, that, while on the voyage, they supposed that they were going on a marauding expedition either to Italy or to Sardinia " The passage in Justin is really stronger than as quoted by Airy, the troops did not realise at the time that it was Africa where they had landed (tunc primum exposito in Africae litore exercitu consilium suum omnibus aperit), they appear to have thought that they were in Italy or Sardinia, and consequently they must have passed through the Straits of Messina, and subsequently kept out of sight of land until Africa was reached

If, as we believe Agathocles had really planned events exactly as they turned out, he would have ordered his partisans at Gela to send provision ships directly there was a strong south wind, and he probably gave them to understand that he would come to their assistance, and that there would be a naval battle, in which the provision ships might turn the scale Agathocles must have had bitter enemies in Gela, as he had just perpetrated an atrocious massacre there, and we may assume that his partisans there were bound to him by self-interest only, and had no idea of being sacrificed to the Carthaginians merely that Agathocles might escape

Enough of his false plans had been allowed to leak out to the Carthaginians for them to suppose that he was coming out of Syracuse to give battle, it was only at the last moment that the Carthaginians, and perhaps also the men of Gela, realised that he was merely bent on escape from Syracuse Meanwhile he had allowed his men to think that they were bound for Sardinia Had they steered south his men would have thought that Agathocles was not acting according to a prearranged plan, but from hand to mouth as best he could If they steered north his men would have felt the confidence engendered by seeing everything going according to the programme If Agathocles had laid his plans beforehand, he would probably have collected information as to currents in the Straits of Messina, and would have known that, in the early afternoon of the day preceding new moon, there is a five-knot current running northwards (Mediterranean Pilot) This current may possibly have contributed materially to his escape, for he seems to have been hard pressed (ἀνελπίστου σωτηρίας ἔτυχε) If he went northward, it certainly adds ten miles to the distance he would otherwise have traversed by the time that he saw the eclipse

P H COWELL

SCIENTIFIC INVESTIGATION IN INDIA[1]

THE Board of Scientific Advice was constituted in the year 1902 by the Government of India as a central authority for the coordination of official scientific inquiry, its object being to ensure that the work of research was distributed to the best advantage, that each investigator employed by Government should confine his researches to the subject with which he was most capable of dealing, and that energy should not be wasted by the useless duplication of work or misdirected by a lack of inter-departmental cooperation It was, more especially, hoped by the Government that the Board would materially assist it in prosecuting research in those questions of economic or applied science which are of direct practical importance, and thus contribute towards the solution of those problems and matters on which the progressive prosperity of the country more especially as regards its agricultural and industrial development, so largely depends

The Board includes the Secretary to the Government in the Department of Revenue and Agriculture which controls and administers the various scientific and semi-scientific departments, and the heads of those departments, including the Surveyor-General of India, the Director-General of Indian Observatories, the Directors of the Geological and Botanical Surveys of India, the Inspectors-General of Forests of Agriculture, and of the Civil Veterinary Department

It advises generally upon the operations of the departments, discusses the programmes of work and investigation of each departmental head submits annually to Government a general programme of research embodying the proposals of departmental heads in so far as their subjects are to be exclusively dealt with in one department and its own proposals when two or more departments are to cooperate, and also at the end of the year prepares a review stating briefly the actual results of the work of investigation carried out during the previous year in the scientific departments The programmes and reviews are communicated through the Secretary of State to the Royal Society, which has selected suitable committees to consider the reports and advise Government chiefly on the scientific problems presented or indicated by the reports

The necessity for some such arrangement has forced itself upon the Government of India with the rapid extension of scientific investigation during recent years Private enterprise in such work is practically nil in India, and hence Government has to initiate all scientific investigation that is necessary for the well-being and progress of the Empire India is at the present stage a country with limited resources, the development of which depends upon the application of modern scientific methods and knowledge to pressing economic problems The heads of Government can gauge the requirements and initiate departments of inquiry and research, and state for

1 Report of the Board of Scientific Advice for India for the Year 1904 5

their guidance the general problems with which they have to deal. In order to control the work of their scientific experts, and to direct it on utilitarian and practical lines, they have found out that it is desirable to obtain the opinion of their scientific officers as a whole, and of a final independent scientific authority, viz., the Royal Society. In this way the Government secures the cooperation of its whole body of scientific officers, and also the execution of the work of research in the most efficient and economical manner, and on the practical lines which it desires. Research is, in fact, directed to practical problems that require early solution, and is not wasted on inquiries which are only of importance from the theoretical standpoint.

The report is full of interest. It shows the wide range of problems with which the departments dealt in the year 1904–5, and the results of their work.

A series of experiments was carried out during the year at the Cawnpore experimental farm similar to those at Rothamsted. It was, for instance, ascertained that of the 43.3 inches of rain which fell during the monsoon period of 1904, 5 inches were required to make up the evaporation during the previous dry period, about 9 inches were taken up by evaporation during the monsoon, 4 inches ran off the surface during a very heavy fall in September, and the remainder, 25.7 inches, percolated. The records also established that the amount of percolation is proportionate to the rainfall, and that the quantity of water lost by evaporation from the soil is greater during the four months of the monsoon than during the eight months of the dry season. These results are in general accordance with the Rothamsted records, and hence probably apply to the whole of the plain of northern India.

The Geological Department issued during the year the results of a special investigation into the Dalhousie earthquake of April 4, 1905. It was one of the most destructive earthquakes which has visited India for many years. At least 20,000 human beings are estimated to have perished. The shock was sensibly appreciable over an area of 1,625,000 square miles. The main focus was at a depth of from eighteen to thirty miles below the surface in the Kangra district. The larger waves reached Bombay and Calcutta at almost exactly the same instant. As both places are at the same distance from Kangra, the rate of transmission in both directions was the same, viz. 1.98 miles per second. The seismograph records of Kodaikanal indicated a speed of 1.95 miles per second, and the Japanese seismographs 2.05 miles. The results hence apparently indicate that the earthquake waves travelled out to the east and south at a rate of almost exactly two miles per second.

The report of the Survey Department is especially interesting. The following extract gives a very brief account of the survey work carried out in Thibet during and after the expedition. "Triangulation was executed connecting Lhasa with India, and fixing all prominent peaks, the country was surveyed and charted on a scale of 4 inches to the mile, the valley of the Brahmaputra was surveyed from Shigatze to its source, the Manasarowar lake region was surveyed, as also the source of the Gartok branch of the Indus and the Thibetan source of the Sutlej. The work was carried out in the face of many difficulties in a country with an average elevation of 16,000 feet and a climate of Arctic severity." One of the interesting results of the expedition was to establish that Everest is, so far as is yet indicated by exact measurement, the highest peak in the Himalayas. Sir Richard Strachey, one of the greatest authorities on Himalayan geography, suggested many years ago the possibility of peaks exceeding 30,000 feet awaiting discovery. All recent investigation appears to establish that it is extremely improbable that there is any peak higher than Everest. It was also ascertained during the Thibetan survey that neither in Nepal nor Thibet is Mount Everest known to the inhabitants by any native name.

The pendulum operations of the Survey of India are furnishing results of great interest. By means of pendulum observations the force of gravity can be ascertained at any place, and as conducted by the survey with the greatest care and delicacy, it can be obtained with a probable error of less than 1 part in 100,000 of its actual value. The earliest observations of this class in India were carried out by Major Basevi upwards of thirty years ago in the western Himalayas. The results of his observations indicated that the force of gravity on the lower Himalayas was considerably less than its value as deduced by geodesists from theory. The deficiency in one case, that of Moré, at an elevation of 15,400 feet, was about 1/2000th part of its theoretical value, and equivalent to the reduction of what may be termed the effective level above the sea of Moré to only 700 feet. It was hence inferred that this deficiency was due to an actual deficiency of matter below, and hence generally that the excess of matter forming the Himalayas is probably, as a whole, compensated by a deficiency of matter in the interior of the earth beneath the mountain mass.

Major Lenox Conyngham recently carried out a lengthened series of pendulum observations. The chief results of his work are that there is a deficiency of gravity (that is, the actual is less than the theoretical value) along and over the outer ranges of the Himalayas. The compensation hitherto assumed to exist as a result of Basevi's measurements is shown by Conyngham's observations to be only partial and not complete. Further south, in the Indo-Gangetic plain, the deficiency disappears and is replaced by an excess. Probably when sufficient data are available it may be possible to formulate a theory of Himalayan structure.

Much valuable work was done during the year in the field of agricultural botany. Amongst the subjects of inquiry was that of the possible deterioration of the jute plant in Bengal. It was ascertained that there is not only no proof of any deterioration, but strong evidence that the plant is now precisely as it was a century and a half ago. The best kinds now, as then, if cultivated liberally, yield excellent crops, and their fibre, if properly extracted, is also excellent. Fraudulent watering in the preparation of the fibre is resorted to with the object of fictitiously increasing its weight for sale. The deterioration of the fibre (not the plant) is due to the fact that the demand for good jute exceeds the supply, and hence that inferior fibre is readily purchased.

As showing the value of the cooperation of the Board of Scientific Advice and the advisory committee of the Royal Society, it is sufficient to mention that they both suggested the necessity for increase of officers in the Geological Department in order to carry out the survey of the geology and mineralogy of Burma. The Government of India accepted the suggestion, and recently sanctioned the addition of four officers to the strength of that department.

The Board is, as shown by the report, doing valuable service in India by coordinating and promoting scientific work, and it is much to be wished that the English Government would adopt some similar plan, and revise the scheme of operations of its chief observatories at Greenwich, Kew, and South Kensington.

NOTES

The Bureau des Longitudes of France has decided to send to Samarkand a scientific expedition to observe the eclipse of the sun which will be visible in Central Asia on January 13, 1907 M Stefanik, astronomer attached to the Meudon Observatory, who accompanied the director Dr Janssen, in the expedition for the observation of the solar eclipse of August, 1905, has been selected as the chief of next year's expedition M Hanski, of the Pulkowa Observatory will join him at Samarkand, and will be in charge of the Russian expedition for the same eclipse M Stefanik, who is now completing his preparations for departure, will take a kinematograph to reproduce the principal scenes of the observation of the eclipse by the French Russian and other missions

Weather prophecy in the United States promises to make a distinct step in advance with the commencement of November Arrangements have been made with the Central Physical Observatory at St Petersburg for reports practically covering the great land area lying between the Russian capital and the Pacific a region embracing nearly one-half the girth of the globe Cable communications with Iceland, together with the facilities now afforded for weather messages by wireless telegraphy, will complete the information for the entire zone of the earth's atmosphere These facilities will enable the U S Weather Bureau to extend considerably the area covered by its present forecasts, and to issue them for a longer period in advance In winter, which is the stormy period of the year, Iceland embraces about the centre of the Atlantic low-pressure area, and the barometer changes experienced will afford much useful information Indian meteorologists have long gauged the importance of the weather conditions over Asia for the framing of long-period forecasts, and a careful study of the minor atmospheric changes over-riding the more permanent seasonal conditions of this vast continent will doubtless aid much in advancing our knowledge of atmospheric circulation

Reference has already been made (October 11, p 591) to the banquet given to Sir William Perkin in New York on October 6 *Science* of October 19 contains a paper read on that occasion by Dr Hugo Schweitzer describing the influence that the discovery of the mauve dye has had upon the progress of chemical science and a report of Sir William Perkin's own account of the discovery of this dye and the development of the coal-tar colour industry started by it

The *British Medical Journal* announces that a congress of practical hygiene will be held in Paris on March 26–31, 1907, under the presidency of Prof R Blanchard The work of the congress, which will deal with food alcoholism, the rearing of children, the workshop, country life, and the colonies, will be distributed among eight sections The general secretary of the congress is M Schaer-Vézinet

Before leaving South Africa, Sir David Gill, K C B, F R S, who will retire in February next after occupying the post of Astronomer Royal at the Cape since 1879, was entertained at a farewell dinner Science, art, politics literature, commerce, and other spheres of human activity were represented, and many testimonies were borne to the services rendered to science and to South Africa by Sir David Gill The Hon E H Walton, in proposing the toast of "Our Guest," referred to the active part taken by Sir David Gill in founding the Association for the Advancement of Science in South Africa, his work in laying the foundations of a complete accurate survey of the Cape peninsula, and his contributions to the progress of astronomical science by observations at the Cape Observatory established by him In his reply, Sir David Gill took the opportunity to insist that all progress in the arts has followed the pursuit of pure science, and incidentally directed attention to his own efforts in organising new work and in urging the Government to provide funds to carry out necessary improvements

The *Home and Counties Magazine* for October contains an article, with portrait on "Peter the wild boy" who was found in the forest of Hertswold near Hanover, in 1725, and was brought to this country by order of Queen Caroline in the following year After ineffectual attempts had been made to get him to speak and to educate him he was ultimately established first at one and then at a second farm near Northchurch Herts, where he died in 1785 The current statements as to his great climbing powers and his habit of going about on all fours were denied by the then headmaster of Berkhamsted Free School to whom Peter was well known Various matters connected with local history, architecture church plate monumental brasses &c form the subjects of the other articles in the same issue

In the course of an address delivered at the eighteenth annual meeting of the Association of Economic Entomologists, and published in Bulletin No 60 of the Entomological Section of the U S Department of Agriculture, Mr H Garman alluded to the prominent position now occupied by the economic entomologist He it is the speaker claimed who has enlisted the attention of the public and educated it to the importance of entomology as applied to agriculture and other human concerns The pure science worker would never have done this, and it thus has happened that the entomologist who was at one time looked down upon by his fellow-worker with something in the nature of disdain has taken first place in the estimation of the general public and demands attention when the recluse laboratory worker gets little consideration And this is as it should be The economic entomologist can claim all entomology as his " The rest of the issue is mainly devoted to an account of the work of the U S Bureau in fighting insects injurious to man and cattle, or harmful to crops and trees in the United States and its dependencies The attention of those concerned may be directed to the fact that on account of preoccupation, the generic term Pyrosoma (see p 17 of the Bulletin) is not available for the organism of Montana spotted fever

Two additions to the literature arising out of the British Association visit to South Africa have recently reached us One is a small illustrated handbook by Dr Haddon F R S published by the Union Castle Company and dealing with the general features of South Africa and his impressions formed during the visit The other is a contribution by Mr C F Rousselet on the Rotifera of South Africa in the Journal of the Royal Microscopical Society for August It contains lists of all the known species of South Africa As the author points out collecting except at such places as the Victoria Falls, was difficult owing to the shortness of the visit and the general dryness of the country, but if one may judge from the large ratio which Mr Rousselet's specimens bear to the total number of recorded species there must be plenty of work for any residents who will search for ponds and ditches in any part of South Africa On the ship, going and coming Mr Rousselet took daily observations of the plankton contained in the hose-water

"EDIBLE Earth in New Guinea" is the title of a communication by Mr W Meigen published in *Briefe der Monatsberichte der deutschen geologischen Gesellschaft* (1905, pp 557–564) The earth in question is found on the east side of New Mecklenburg, where it is associated with decomposed coral, its main constituents are oxides of silica and aluminium, there is a smaller quantity of ferric oxide and traces of other substances, including ammonia Mineralogically, the earth is composed of kaolin, hydrargillite, and ferric oxide, it is a fatty clay of yellowish colour not unpleasant to the taste and composed of very small particles It is used for medicinal purposes and may well counteract the laxative effects of the fish diet of dwellers on the coast The article mentions the more important previous contributions to the discussion of the question of edible earths, of which, however, but few analyses have been published A recent paper was noticed in NATURE of September 27 (p 543), in vol xxxiii of the Journal of the Royal Society of New South Wales was published the analysis of some kaolinite from Fiji

THE Bulletin of the Johns Hopkins Hospital for October (xvii No 187), in addition to articles of medical interest, contains an account by Mr D I Macht of Moses Maimonides, a celebrated Jewish philosopher of the thirteenth century, who was physician to the Sultan Saladin and his successor, and the author of many religious philosophical, and medical works In his "Ethics" a complete system of practical hygiene is given which would well compare with the most recent text-books on the subject, lack of exercise, over-eating alcohol and excess are summarised as the causes of most diseases Dr T R Boggs describes a simple method for the quantitative estimation of the proteids in milk The diluted milk is precipitated with phosphotungstic acid in hydrochloric acid solution, and the volume of the precipitate is read off in an ordinary Esbach albuminometer tube as used in wine analysis The method is accurate to within 0 3 per cent to 0 7 per cent, according to controls made by Kjeldahl determinations

As agriculture in the Virgin Islands is dependent upon small cultivators progress is hampered by the want of capital In the annual report for 1905–6 of the experiment station maintained at Tortola, the curator, Mr Fishlock, notes that the peasants are gradually realising the advantage of planting such permanent crops as cacao, limes and rubber The department also fosters cotton cultivation by supplying seed, buying seed-cotton, and preparing the lint for market

THE July number of the Trinidad Bulletin contains the annual report for the past year, by Mr J H Hart on the Botanical Department Seedling canes, rubber, and cacao form the largest items under plant distribution, there was also a considerable demand for young trees of Honduras mahogany, *Mimusops globosa*, that furnishes *balata* and *Cedrela odorata*, the West Indian cedar With the view of popularising its cultivation, a large number of plants of *Coffea robusta* was given away In a note on the nests of Trigona bees it is observed that the peculiar trumpet-shaped entrance is connected with the danger to returning bees of being caught by a spider that lurks near the opening

THE second number of the Memoirs of the Department of Agriculture in India is devoted to the subject of Indian wheat rusts Three distinct species, *Puccinia graminis*, black rust, *Puccinia glumarum*, yellow rust, and *Puccinia triticina*, orange rust, are commonly found It was observed in 1904 that the first was most rampant in Central India, while the latter two predominated further north, and therefore nearer the district where barberries are found The authors Mr E J Butler and Mr J M Hayman, have at present no explanation to offer for the origin of the disease year by year The results obtained by inoculating barley with rust spores taken from wheat plants and *vice versâ* show a considerable degree of specialisation, as very few of the inoculations succeeded

THE superintendent of the Indian Museum, Calcutta, mentions in his annual report for the year 1905–6 that a number of Tibetan and Bhutanese specimens, chiefly robes, brass ware, and religious objects, was added to the art and ethnological collections, also various agricultural instruments from Assam The report of laboratory work by Mr D Hooper contains, as usual, several interesting analyses From the shoot of the common bamboo a food product is prepared, known in Assam as *gass-tenga*, that is eaten with rice, this contains an acid similar to aspartic acid that is probably derived from asparagin Specimens of the bark of *Picrasma javanica*, used by the Karens as a febrifuge, yielded a bitter principle allied to quassiin The analyses of latices from a number of different species of Ficus show that of those examined *Ficus elastica* alone furnishes rubber of commercial importance

ATTENTION is directed in the Journal of the Society of Arts (vol liv, No 2812) to the soda lakes of Mexico on the great desert south of Yuma These vast lakes of crystals of carbonate of soda are within 3000 yards of the sea They are the property of the Mexican Government, and it is believed that they may become sources of enormous income to the country

THE British Commercial Agent in the United States reports that the plan of storing coal under water is being adopted at a new plant west of Chicago Twelve large cement-lined pits have been constructed with a bottom of clay soil Their storage capacity is 14 000 tons A 12-inch water pipe opens to the pits near the top, so that the coal can be flooded when required

IN the *Engineering Magazine* (vol xxxii, No 1) Mr Alfred Sang urges the practical value of industrial museums as exemplified by the Conservatoire des Arts et Métiers in Paris, and what was originally the Patent Office Museum at South Kensington While satisfactory results must depend upon a board of management composed of experts in the various branches of science and of industry represented, the author gives examples of exhibits that would prove of special benefit to students

IN the Journal of the Franklin Institute (vol clxii, No 4) Prof Alfred J Henry, of the U S Weather Bureau, gives an account of weather forecasting by synoptic charts. The method is based on two well-established facts, the general eastward drift of the atmosphere in temperate latitudes in the northern hemisphere, and the close relation that subsists between the weather and the distribution of atmospheric pressure Within recent years there has been an appreciable gain in the accuracy of the forecasts The period covered by the forecasts has been extended from eight to forty eight hours, and instead of forecasts expressed in very general terms for large areas, definite forecasts are now made for all the larger towns and for each of the States and territories The most important gain however, is in the adaptation of the forecasts to the needs of special industries, the perfection of the system of flood warnings, and the general improvement in the warnings of severe storms and cold waves

THE second part, dealing with labour, of the General Report on Mines and Quarries, has been issued by the Home Office as a parliamentary paper (Cd 3179, price 10d) It shows that the total number of persons employed at British mines and quarries in 1905 was 982,343, of whom 887,524 were employed at mines and 94,819 at quarries During the year, 1103 separate fatal accidents occurred at mines and quarries, causing the loss of 1304 lives Compared with the previous year, there is a decrease of fifty-five in the number of fatal accidents, and an increase of 102 in the number of lives lost The general death-rate from accidents at mines was 1 358 per 1000 persons employed Of the fatal accidents at mines, 44 0 per cent were caused by falls of ground Five fatal accidents were caused by the use of electricity underground A very unusual accident is reported at Llanhilleth Colliery, where one man was killed and six men injured by the sudden blast of air caused by a fall from the side of a cavity Some interesting statistics are given showing that gunpowder constituted more than 67 per cent of the total weight of explosives used in collieries About 30 per cent of the weight used consisted of permitted explosives, those most largely used being bobbinite, saxonite, ammonite, roburite, and westfalite Other statistics show that there were 295 collieries where coal-cutting machines were at work, the total number of machines being 946 The total quantity of coal obtained by the aid of these machines in 1905 was 8 102,197 tons

WE have received from the director of the Geological Commission Cape Town, South Africa, the first separately issued sheet of the geological map of Cape Colony The geology is by the director Mr A W Rogers Mr E H L Schwartz, and Mr A L Du Toit The colour printing is clear and there is not too much detail The size of the imprint is 21½ inches by 27 inches, the scale is 1 inch = 1600 Cape roods which is equivalent to about 3 7 miles to the inch The commission is to be congratulated upon the production of an excellent map

PART 1 vol xxxiv of the Records of the Geological Survey of India contains two reports upon occurrences of coal, one in the foothills of Bhutan by G E Pilgrim, the other in the Kotli Tehsil of the Jammu State (Dandli coalfield), by C M P Wright Mr Pilgrim contributes also some notes on the geology of Bhutan, Dr Diener supplies notes on some fossils from the Halorites limestone of Bambanag Cliff, in which he describes a new genus, Martolites near to Celtites of Mojsisovics, and a new species of Halorites *H trotteri* He also describes the Upper Triassic fauna of Pishin In the appendix, analyses are given of three samples of muds from the Travancore coast

THE *Rendiconto* of the Bologna Academy is sometimes rather late in appearance, but the three last numbers (1902–5) contain one or two papers of more than passing interest Prof Guido Tizzoni in the name of Dr Bongiovanni read a note on the influence of radium on the virus of rabies It was shown that radium rays rapidly destroyed the virus, both when contained in tubes and when applied to animals within an hour or so of their infection, and methods were found by which animals already suffering could be cured with certain results The previous number (vol viii) contains an account of the botanical results of the two scientific expeditions to Montenegro organised by the Italian Government in 1902 and 1903

A PAPER by M Edouard Collignon on the solution of the cubic equation is published in abstract in the Proceedings of the Edinburgh Mathematical Society, xxiv (1906) It is based on the property that every cubic can be reduced to one of the three forms x^3 = constant or $x^3 \pm x$ = constant By tabulating the values of x^3+x and x^3-x for different values of x, the roots may be found in the same way that antilogarithms are taken from a table of logarithms The properties of the roots are discussed in connection with the graphs of $x^3 \pm x$ and it will be noticed without going further into the details of the paper that the turning points of the curves determine very simply the conditions for three or one real roots The author examines how far a similar method is applicable to curves of higher degree

WE have often directed attention to the excellent series of monthly volumes entitled the *Practical Photographer* edited by the Rev F C Lambert, and published by Messrs Hodder and Stoughton It was found that the size of page was rather too small to show off effectively the fine reproductions from well-known photographs which were a distinct feature of the series In April last the size of page was doubled and since that date we have received the monthly issues which indicate the wise policy of such a change The present series is now termed the *Practical and Pictorial Photographer*, and is issued as a library series the price being the same as the previous volumes namely one shilling The October number is full of interesting matter and is illustrated by seventeen reproductions

FROM Messrs Newton and Co we have received a simple convex lens of 2 5 inches diameter having a focal length of about 6 feet On a small portion of the periphery of the lens is firmly sealed a metal base carrying a small screw which enables the lens to be easily fixed to the end of a walking stick or umbrella The lens and attachment are enclosed in a neat leather case, which can be comfortably carried in the waistcoat pocket This "unilens," which has recently been patented by Major Baden Powell, serves the purpose of a low power pair of opera-glasses without the trouble of carrying them The use of such a lens in this manner is not new, but the present form of mounting will make it of more general service than hitherto Those who possess approximately normal eyesight would find great comfort in having ready at hand such an easy means of magnifying distant objects When placed on the end of a stick and the latter held out at arm's length, the object observed is seen at the greatest magnification and even at less distances the object is always in focus, but not so much enlarged The simplicity and portability of this "unilens" should find favour with many who are in search of a pocket telescope

THE first part, comprising no less than 1437 titles of a valuable catalogue of important works, chiefly old and rare on mathematics, astronomy physics, chemistry and kindred subjects has just been issued by Messrs H Sotheran and Co This "Bibliotheca Chemico-mathematica" will be completed in three or four parts which will be issued at intervals of a few months each The part just received has on the first page works by Ernst Abbe, Abel, and Abercromby, and the last titles are of works by Galileo Among numerous other volumes and memoirs included in the catalogue are a copy of the very rare first edition of the great work of Copernicus "De Revolutionibus Orbium Cœlestium" (1543) which commenced a new epoch in the history of astronomy the first

printed edition of Euclid's "Elementa Geometriæ" (1482) the first edition of de Caus's "Les Raisons des Forces mouvantes" (1615), to which, according to Arago, is due the invention of the steam engine, Daguerre's description of his invention of the Daguerreotype process of photography (1839), and the earliest works on ballooning. Bibliophiles and librarians looking out for scientific works of great rarity and interest, or for volumes of Proceedings of scientific societies and standard books on the exact sciences, will find it an advantage to consult the interesting catalogue, the first part of which Messrs. Sotheran have just published.

MESSRS. GEORGE PHILIP AND SON, LTD., will shortly issue a novel perpetual calendar invented by the Rev. J. W. Wiles. It is claimed that by a simple arrangement the calendar will show the day of the week of any day in any year from the beginning of the Christian era to the end of time.

MR. W. A. SHENSTONE, F.R.S., has revised, and in some instances amplified, the essays he recently contributed to the *Cornhill Magazine*, and they will be published by Messrs. Smith, Elder and Co. to-morrow under the title of "The New Physics and Chemistry: a Series of Popular Essays on Physical and Chemical Subjects."

MESSRS. ARCHIBALD CONSTABLE AND CO., LTD., will publish very shortly a volume by Prof. E. Ray Lankester, F.R.S., entitled "The Kingdom of Man," containing a statement of the present position of scientific knowledge and the promise of the future.

THE second quarterly number of *Science Progress in the Twentieth Century* has now been published by Mr. John Murray. The ten articles included in this issue of the new scientific quarterly review range over many departments of science, and should appeal to a wide circle of readers.

THE first parts of two works of science which are being published serially by Mr. Fritz Lehmann, Stuttgart, have been received. "The Macrolepidoptera of the World" by Dr. Adalbert Seitz is to be completed in 100 parts, and "Das Mineralreich" by Dr. Reinhard Brauns, in seventy-five parts. Both works are illustrated by excellently produced coloured plates. Messrs. Williams and Norgate are the agents of the publishers in this country.

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN NOVEMBER:—

Nov. 5	11h. 24m. to 12h. 34m.	Moon occults ν Geminorum (mag. 4·1).
9.	9h.	Mercury at greatest elongation (E. 23° 0').
10.	12h. 17m. to 13h. 33m.	Transit of Jupiter's Sat. IV. (Callisto).
11.	7h. 15m. to 10h. 15m.	Transit of Jupiter's Sat. III. (Ganymede).
15.	Saturn.	Major axis of outer ring = 41"·27, minor = 4"·64.
,,	9h. 33m.	Minimum of Algol (β Persei).
15.	Venus.	Illuminated portion of disc = 0·070, of Mars = 0·959.
15–16.		Epoch of November Leonids (Radiant 151° + 23°).
17–21.		Epoch of November Andromedids (Radiant 25° + 43°).
18.	6h. 21m.	Minimum of Algol (β Persei).
18.	10h. 45m. to 13h. 46m.	Transit of Jupiter's Sat. III. (Ganymede).
19.	5h. 30m. to 6h. 34m.	Moon occults σ Sagittarii (mag. 3·9).
25.	14h. 11m. to 17h. 12m.	Transit of Jupiter's Sat. III. (Ganymede).

GREENWICH OBSERVATORY AND THE POWER STATION.—At the meeting of the Astronomische Gesellschaft recently held in Jena (September 12–15) Dr. Foerster directed attention to the erection of the large generating station near to Greenwich Observatory and the consequent interference with the work of the institution. After Prof. Dyson had described the unfavourable position in which the observatory is situated, a resolution having the following effect was passed:—That the convention of the International Astronomische Gesellschaft, meeting in Jena, in view of the communication made in the latest report of the Greenwich Observatory, expresses the hope that the loss which would be occasioned if the observatory were removed may be averted. The resolution also expressed the hope that as Greenwich has succeeded in establishing itself as the standard place, all future proposals to remove it may likewise be averted (*Astronomische Nachrichten*, No. 4127).

LUNAR CHANGES.—In No. 588 of the *Astronomical Journal* Prof. W. H. Pickering discusses Mr. Stebbins's observations of the lunar crater Linné, made during the eclipse of the moon which took place on February 8, 1906, and compares them with the similar observations made at the same time by Prof. Frost. Although some slight doubt exists as to the precision of one or two of Mr. Stebbins's measures, the curve showing the change in diameter of the spot surrounding Linné, according to his observations, agrees in general with the similar one obtained by Prof. Frost. Both show a substantial increase in the diameter immediately after the passing of the earth's shadow. Prof. Pickering ascribes this increase of diameter to the deposition of hoar frost, or something analogous to it, caused by the drop in temperature consequent upon the screening off of the sun's rays by the opaque body of the earth. This phenomenon has now been observed by six observers working quite independently, several of whom were originally prejudiced against it; therefore Prof. Pickering considers that it may be accepted as confirmed.

The variation of the diameter of the spot during the ordinary course of lunation has similarly been confirmed by several observers, one of whom, Dr. C. W. Wirtz, discusses his observations at some length in No. 4118 of the *Astronomische Nachrichten*.

ECLIPSE OBSERVATIONS.—In No. 9, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani* Prof. Riccò concludes his account of the eclipse observations made by the Italian expedition to Alcala de Chivert in August, 1905. Among other matters he discusses "white prominences," and describes those seen during the eclipse in question as faint and indistinct, especially in the lower parts, and appearing as little more than a whitish shadow projected on to the background of the corona. He also suggests that these objects are in nature somewhat of an intermediate stage between the prominences and the true coronal streamers.

Estimating the height of the various layers of the solar atmosphere by two independent methods, Prof. Riccò found that that which he calls the "reversing layer" or the stratum producing the so-called "flash spectrum," extends to some 3" or 2000 km. (1250 miles). That part of the chromosphere which emits D$_3$ and F especially has a height of about 7" to 9", whilst the calcium vapours of the chromosphere extend to about 15" from the base. Photographs taken on special plates with a prismatic camera show that the maximum brightness of the continuous spectrum of the corona occurs in the yellow and red regions.

THE ZODIACAL LIGHT.—During the past summer Prof. Barnard, at the Yerkes Observatory, made a number of observations of the zodiacal light, the results of which he now publishes in No. 2, vol. xxiv., of the *Astrophysical Journal*. On June 22 he paid special attention to the phenomenon, and found it to be much more extensive than he had previously supposed. He concludes that the light extends at least 65° north and south of the sun (assuming the southern extent to be the same as the northern), a value considerably larger than that arrived at by Prof. Newcomb, observing in Switzerland, in the summer of 1905.

THE MIRA MAXIMUM OF 1906.—In No. 4110 of the *Astronomische Nachrichten* Prof. Nijland publishes the results of his observations of Mira made during the period August 24, 1905, to February 24, 1906. The curve accompanying the paper shows that a sharp maximum occurred on January 3, when the star's magnitude was 3·9. This was preceded by a very flat minimum of about the ninth magnitude, extending from the commencement of the observations until November 9, 1905, and then a steep ascent to the maximum. The lowest magnitude, 9·05, occurred on September 23, 1905.

METEOROLOGY OF THE NILE VALLEY.[1]

THE Egyptian Survey Department, constituted some years ago, is adding largely and rapidly to our knowledge of the hydrography, geology, and meteorology of the Nile basin. The director-general, Captain Lyons, R.E., has prepared and issued a monograph dealing very fully with the physiography of the Nile basin. In this work, which was reviewed in NATURE of September 6 (vol. lxxiv., p. 461), he combines the results of former observers and investigators with the data accumulated during the past ten or twelve years by his department. It is a storehouse of information relating to that most remarkable, and until recent years most mysterious, of rivers.

We propose to give a brief statement, based on the information contained in the monograph, of the more important features of the meteorology of the Nile Valley and their relations to the physiography of the whole area.

The river obtains its supplies from two collecting areas, one the equatorial lake plateau (between lat. 5° S. and lat. 5° N. and long. 28° and 35° E.), and the second the Abyssinian mountain and plateau area (between lat. 7° N. and 14° N. and long. 35° and 40° E.).

The former is the larger catchment basin, and includes the Victoria, Albert Edward, and Albert Lakes, which serve as reservoirs to store the rainfall of the whole region. The Victoria Lake (equal in area to Scotland) is about 4000 feet above the sea, and is slightly lower than the mean level of the plateau. The ground rises slightly to the south and east, and rapidly to the west to the elevated peaks of Ruwenzori, which separate it from the rift valley, in which are situated the Albert Edward and Albert Lakes connected by the Semliki River. The catchment area of the Victoria Lake is only of comparatively small extent, not more than twice the area of the lake, the level of which hence varies very slightly with the season. The Victoria Nile, which issues from the north of the lake, is precipitated over the Ripon Falls, and thence passes over flat marshy ground to the Choga Lake Swamp, and descends by a series of rapids and finally by the Murchison Falls, to the lower level of the Albert Lake at its northern extremity in lat. 2½° N.

The Albert Edward and Albert Lakes, with their tributaries, appear to collect a larger volume of water than the Victoria Lake. The Victoria Lake discharges by the Victoria Nile a nearly constant amount averaging 500 cubic metres per second, and the Albert Lake amounts varying between 500 and 1100 cubic metres per second.

The discharge of the lake system is carried off northwards from the Albert Lake by the Bahr-el-Jebel or Albert Nile, as it is called by Sir William Willcocks. It descends rapidly from a level of 2300 feet to 1500 feet at Gondokoro (lat. 5° N.) in a narrow channel with numerous falls and rapids, and thence to Lake No (lat. 9½° N.) through an extensive flat and swampy region. It is joined at Lake No by the Bahr-el-Gazal, and about eighty miles further down stream by the Sobat. The former drains a large portion of the Soudan, its head-waters being chiefly in the equatorial belt. The Sobat is formed partly by drainage from the same belt and partly from the southern face of the Abyssinian plateau.

Between Lake No and Khartoum the main stream is now known as the White Nile. The discharge of this river below Lake No varies to a slight extent during the year, and averages only 350 cubic metres per second, and hence considerably less than the supply passing into the river from the Albert Lake. The difference represents the loss by evaporation in the extensive swamp region through which these streams flow. That of the Sobat is only considerable during the rainy season, from April to December, ranging between 380 cubic metres and 1470 cubic metres per second. The White Nile below the junction of the Sobat (lat. 9½° N.) to Khartoum (lat. 15½° N.) receives no affluent, and flows in a broad valley as a wide stream of moderate velocity. This part of the Nile plays a subordinate but important *rôle* with respect to the Nile floods. From May to September the flood water brought down by the Sobat River is ponded up or held back in this reach of the Nile, and hence does not contribute to the Lower Nile flood. Captain Lyons states that this action stores up an average of about 1500 million cubic metres from the Sobat flood, which is supplied to the Nile in October, November, and December, thus prolonging the period of the Nile flood, and delaying the fall of the Nile to its low-water stage.

The main flood water of the Nile is brought down by the Blue Nile and the Atbara from the Abyssinian plateau. The rainfall occurs between June and September, and is immediately discharged down the hills into the valleys, the greatest portion down the Blue Nile, which joins the White Nile (there forming the Nile) at Khartoum. The maximum flood of the Blue Nile is about 12,500 cubic metres, and of the Atbara 5000 cubic metres, per second.

The Nile flood proper is hence due solely to rainfall in the Abyssinian and adjacent Soudan area. It commences in June, and reaches its maximum about the end of August or beginning of September. The maximum height of the Nile flood, or the total discharge during the flood period, may hence be accepted as a measure of the total rainfall over that area, just as the variations of the Victoria and Albert Lakes represent the seasonal variations of the rainfall in their catchment areas.

The Nile below the junction of the Atbara (lat. 18° N. to lat. 34° N.) receives no affluents, and flows in a comparatively narrow valley, over which the flood waters with their rich alluvial contents are distributed by means of a vast system of canals.

The Nile basin may hence be divided into three areas or regions not differing greatly in breadth from south to north. The most southerly is the equatorial lake belt between lat. 5° S. and 5° N., an intermediate region between lat. 5° N. and lat. 18° N. includes the Soudan and Abyssinia, and the northerly region comprises the lower Nile basin from lat. 18° N. to the Mediterranean in lat. 34° N. The low river supply (January to May) is chiefly due to discharge from the equatorial lake area, and the summer flood supply to discharge from the Abyssinian region.

The following gives a sketch of the more important features of the meteorology of the Nile basin based on the important information and data of Captain Lyons's monograph.

Temperature is remarkably uniform in the equatorial lake region. Thus at Entebbe, on the north shore of the Victoria Nyanza, it ranges only between a mean of 72°·7 in January and 70° in July. In the Nile basin north of about lat. 5° N. temperature is lowest in January, and attains its maximum in May in the southern half of the valley south of Khartoum, and in July in Nubia and Egypt. The annual range of temperature increases northwards from the equatorial belt to northern Egypt. The greater part of the Nile basin is within the tropics, and is throughout the whole year characterised by high temperature. That portion of it between lat. 15° N. and lat. 18° N. (in which are the meteorological stations of Khartoum, Berber, and Dongola) is the hottest and driest area in the Nile basin. It has an elevation of about 1200 feet. To the south is the comparatively damp and cooler region of the Bahr-el-Gazal, the Albert Nile, and the lake plateau, whilst to the north the valley descends slowly to the relatively cool Mediterranean coast. This—the Soudan hot area—is one of the hottest regions in the world. The following gives a comparison of the mean monthly maximum temperature of Berber in that area, and of Jacobabad, the hottest station in India, and also of Massowa, on the Red Sea, in the same latitude as Berber:—

[1] "The Physiography of the River Nile and its Basin." By Captain H. G. Lyons, R.E., Director-General Egyptian Survey Department.

Mean Maximum Temperature

	Berber, Lat 18° N	Jacobabad, Lat. 28 N	Massawa, Lat. 15 N
January	86.7	73.6	84.2
February	90.0	77.9	85.3
March	96.6	91.1	87.1
April	106.0	103.1	90.5
May	110.5	111.6	94.5
June	112.1	112.7	99.5
July	108.5	107.8	101.6
August	110.3	103.8	101.5
September	108.5	103.5	97.7
October	104.0	98.6	95.0
November	96.0	86.8	89.6
December	89.6	76.7	86.9

The data show that at the hottest period from May to September, the high-temperature conditions are as intense in the Soudan hot area as in Upper Sind, and are more prolonged and persistent This hot area plays a very important part in the meteorology of the Nile basin It is throughout the whole year much hotter than Lower Egypt The difference between the mean day temperature at Berber and Alexandria increases from 8° in January to 16° in April and May It thence diminishes under the influence of the monsoon rainfall in the Soudan region to 8° in August and increases to a second maximum (12°) in November It is undoubtedly due to the presence of this permanent hot area in the central Nile basin that northerly winds prevail almost continuously in the northern half of the basin (*i e* north of Berber) The Massawa data also indicate that the hottest portion of the Red Sea is from 10° to 16° cooler during the day hours from March to October than the land area to the west As the width of the Red Sea in lat 15° to 20° N is about 300 miles, it is evident that the presence of this relatively cool area will modify considerably the air movement and pressure distribution in the adjacent land areas, more especially the Soudan comparatively low-lying area.

Much less is known of the pressure distribution than of temperature in the Nile basin Barometric observations are being taken at a considerable number of stations When the elevations of the observing stations have been accurately determined by the Survey Department, it will then be possible to give, for the first time, a satisfactory statement of the changes of the distribution of pressure during the year It is to be hoped that this information will be available in Captain Lyons's monograph on the meteorology of the Nile basin which we believe he has under preparation Comparison of the temperature conditions of northern India and of the Nile basin suggest the probable pressure scheme Pressure in January and the following three or four months is probably lowest in the interior regions of Africa to the south of the equator An independent local low pressure begins to form in the Soudan hot area in March, and intensifies to some extent in April and May This low-pressure area limits the advance of the monsoon winds in that region in the same manner that the low-pressure area in Baluchistan and Sind and the Himalayan mountain barrier, limit the northward extension of the south-west monsoon winds in India During the period from June to September an extensive low-pressure area extends from the Soudan across south-west Asia to Upper India but it is probable that the Soudan depression, due to the local thermal conditions, maintains an independent existence from the Upper India depression and is separated by a belt of somewhat higher pressure across the Red Sea This is not confirmed as yet by observation Captain Lyons however indicates in the chart of the mean distribution of pressure in northern and central Africa in July his conviction that a local belt of low pressure stretches across central Africa between lat 12° N and 18° N This either fills up in October and November or is transferred southwards

The air movement in the Nile basin is on the whole comparatively simple It is almost continuously from north to the north of lat 17° or 18° N (Berber) and is hence a drift up the valley due to permanent temperature and pressure differences between the east Mediterranean and Upper Nile valley Also in the extreme south of the basin (in the basin of the Victoria and Albert Lakes) it is, so far as is indicated by the available data, almost equally persistent, but from the opposite direction, that is, from south and south-east That region is hence, during nearly the whole year, within the sphere of the south-east trades. The movement is apparently for a short period in the early months of the year light, variable, and irregular, but chiefly from north

The air movement in the intermediate region between the equator and lat 16° N to 18° N is typically monsoon During one period of the year dry land winds (from the north) prevail, followed during the remainder of the year by humid oceanic winds (from south or west) The influence of the Soudan hot area begins to be shown in March, and winds alternate between northerly and southerly directions in April and May Thus at Khartoum the percentage of steadiness decreases from about 90 per cent in January to 40 per cent in May In the beginning of June a change similar to that occurring in India in that month is initiated Steady winds, the continuation of the south-east trade winds, which have previously given heavy rain to the equatorial lake area, prevail during the next three months The direction of the air movement rapidly changes in proceeding northwards from south to west, determined by the position of the Soudan low-pressure area and action due to the earth's rotation The current hence advances directly to the Abyssinian mountain or plateau area, the axis of which runs due north and south, its forced ascent over which gives rise to the heavy precipitation over the greater part of the plateau No rain falls at this time in the Red Sea coast districts on the lee side of the plateau The plateau hence plays (but much more completely) the same part for the Abyssinian branch of the south-west monsoon current that the West Ghats play with respect to the Bombay branch This movement holds steadily until September, when the monsoon current contracts southwards and light, northerly winds extend slowly to the neighbourhood of the equator There is hence a clearly marked monsoon alternation of winds and of season (dry and wet) in the intermediate area between lat 5° N and lat 18° N

The distribution of the rainfall in the Nile basin is very clearly exhibited in a series of monthly charts in Captain Lyons's monograph A chart showing the amount and distribution of the average annual rainfall would have been a useful and valuable addition to the series Charts of annual or seasonal rainfall are, as a rule even more valuable for comparison than charts of monthly rainfall

The air movement has shown that the Nile basin may be divided meteorologically into three areas viz the area of dominant northerly winds (north of lat 17° N), the area of alternating monsoon winds between lat 17° N and the equator, and the area of dominant south-easterly winds south of the equator The rainfall differs greatly in its characteristic features in these three areas In the northerly region it occurs during the winter months, as in Syria, the Euphrates valley, and the Iran plateau, and is small and very variable in amount The average annual fall at Alexandria and Suakim is about 5 inches, at Port Said 2 inches, and at Suez ½ inch In the intermediate monsoon region practically no rain falls from November to April Thunderstorms occur in May, chiefly in the southern districts, and frequent heavy rain from June to September or October according to position The rainfall is heaviest on the western and central portions of the plateau In the Himalayas the rainfall is, as a rule, heaviest at an elevation of about 4000 feet The Abyssinian data are too scanty to show whether there is any line of maximum rainfall lower than the level of the interior plateau or higher mountain ranges, where the highest elevations exceed 15,000 feet

The precipitation in the equatorial lake region has a double maximum and minimum in its annual variation, related, as Captain Lyons points out, to the apparent movement of the sun The rainfall is small in amount during the period of heavy rainfall in the monsoon region from June to September It is heavy from October to December, and again in March and April, and is light to moderate during the intervening months of January and February, and moderate in May

The following summary of the annual rainfall in the Upper Nile basin is taken from Sir William Willcocks's "Nile in 1904." In the catchment basin of the Victoria and Albert Lakes, the mean annual rainfall may be taken as 50 inches, with large fluctuations between good and bad years; over the Albert Nile region it is about 40 inches, with severe droughts occasionally and excessive rain in some years In the catchment basin of the Sobat River it probably averages 40 inches, and in that of the Bahr-el-Gazal region 30 inches The rainfall over the Abyssinian plateau may be taken as 50 inches, and in the lower reaches of the Blue Nile and Atbara 30 inches These are undoubtedly rough estimates, but, so far as can be judged from the exact data given for a number of individual stations in Captain Lyons's work, they are approximately correct values They also indicate that the mean annual rainfall over the Upper Nile basin differs little from 40 inches This is a somewhat remarkable result, as it agrees closely with the average rainfall in India, which, according to Blanford, is 42 inches

The rainfall in the equatorial lake belt resembles in its seasonal distribution that of Ceylon, and that of the intermediate region (the Soudan and Abyssinia) that of western India In western India, as in the East African monsoon region, the cool and dry season is rainless, with clear skies and light to moderate land winds The rains in each agree in period, in the comparative suddenness of the change from the dry to the wet season, in the occurrence of almost daily heavy rainfall, and also in the rapid withdrawal of the humid currents at the end of the season The meteorological data indicate clearly that the rainfall in both areas is due to the rapid extension of the south-east trade winds northwards from the equatorial belt at the same critical epoch, and probably under the same general conditions There is one very important difference The monsoon current in the Nile basin does not extend beyond lat 16° to 18° N, being bounded to the north, not by a range of mountains, but by an area of permanent low pressure during the season, due to thermal actions It curves rapidly from south to west, and is hence determined directly to the western face of the Abyssinian plateau and mountain masses which in their highest points attain an elevation of 15,000 feet The Bombay current in India extends as far northwards as the East Punjab (lat 30° to 35° N) where its further progress is barred by the Himalayas The Abyssinian plateau exhausts the humid current much more completely than the West Ghats as the rainfall at Massowa and other towns on the Red Sea to the east of the plateau is practically nil

It would be interesting to determine whether the humid current is converted into a vertical movement over the plateau or whether it continues to march eastwards, and perhaps to contribute to the monsoon rainfall (of the same period) in the mountain region of Yemen, in south-west Arabia

Captain Lyons has devoted considerable attention to the question of the variations of the Nile flood, and hence of the rainfall in the Nile basin, from year to year The data show that very large variations occasionally occur amounting to ±35 per cent of the mean He infers from the data of years that they do not exhibit any regular cyclical variation, and hence that they cannot be directly correlated with the eleven-year sun spot period or the thirty-five-year Bruckner period

It is now, we believe, fully established that Abyssinia, India, and Burma, with the Malay Peninsula, receive nearly the whole of their rainfall from the same vast reservoir and evaporating area, the Indian Ocean and seas and under the same general meteorological conditions and by means of the same general air movement These facts, on the one hand, indicate a probable similarity or parallelism of the seasonal variation of rainfall in all three areas due to general conditions in the contributing oceanic area, and, on the other, an unequal and unlike variation due to variation of local conditions in the three large areas of distribution, also as the rainfall of the Abyssinian plateau is due to the same branch of the monsoon current as that of western India, any parallelism of variation is more likely to be exhibited by these two regions than by either compared with Burma or north-eastern India (dependent on the Bay monsoon current) The actual variation in any one year will hence be due to the resultant of the general and of the local conditions It is also probable that the largest variations will be due to the general variation over the whole area of supply The data furnished by Captain Lyons are, on the whole in full agreement with these inferences The most remarkable case of similarity of seasonal variation is exhibited by the data of the past fourteen years The following gives comparative data of the rainfall of India and of the Nile floods from 1892 to 1905 The former data are obtained from the Indian meteorological publications, and the latter from Captain Lyons's memoir —

Year	Ratio of mean actual to normal rainfall in India	Ratio of actual to normal Nile flood
1892	1 12	1 20
1893	1 21	0 99
1894	1 15	1 22
1895	0 95	1 15
1896	0 88	1 06
1897	0 99	0 89
1898	1 01	1 07
1899	0 73	0 63
1900	0 99	0 89
1901	0 90	0 87
1902	0 95	0 63
1903	1 05	0 89
1904	? below	0 75
1905	much below normal	0 65
Period 1892 4	1 16	1 14
,, 1895-8	0 94	1 05
,, 1899 1903 or 1905	0 93	0 78

It is a noteworthy fact that the Abyssinian rainfall, as indicated by the Nile floods, is subject to much larger range of variation than the rainfall of India, as might perhaps have been anticipated The data show that from 1892-4 the rainfall in India and in Abyssinia (assumed to be roughly proportional to the total Nile flood) was in considerable excess from 1892-4, about normal from 1895-7 and more or less in defect from 1898 to 1905 The parallelism would have been more exact if the rainfall of western India had been given instead of that for the whole of India The 1896 drought in India was due chiefly to the weakness of the Bay current, and not of the Arabian Sea current It may be noted that the data for the variations of the level of the Victoria Lake agree generally with those of the Abyssinian rainfall, as indicated by the Nile floods Thus according to Captain Lyons 1892-5 was a period of high level, 1896-1902 a period of falling level, and 1903 a year of rising level This remarkable parallelism strictly in accordance with the general simple inferences stated above, suggests two problems for the consideration of meteorologists These are, first, the causes of the large variations from year to year of the rain supply over the immense land area of India the Soudan and Abyssinia, and, secondly, the determination of any invariable antecedent conditions which may serve as indications and be utilised for forecasting these variations Captain Lyons in the last chapter of his memoir takes up both of these problems, but acknowledges that his investigations are only in the introductory stage It is however, interesting that his present conclusions on the whole agree with those of Indian meteorologists He shows, for example that pressure in the Egyptian region is below the normal in seasons of good Nile floods and *vice versâ* This is the usual relation between pressure and rainfall in India, and is also in accordance with theory Captain Lyons also points out that the monsoon variations of pressure are frequently, if not invariably, the continuation of similar conditions which have prevailed for some time previously This is also in accordance with Indian experience He also points out that they are probably in some cases related to the widely distributed variations of pressure studied by Sir Norman Lockyer and Dr Lockyer, and also to the long-period variations in India The latter are marked by or accompany prolonged abnormal variations or anomalies of the Indo-oceanic air movement He also considers that they are occasionally determined by variations in the position and intensity of north-east Atlantic anticyclones This is by no means improbable but until more is known

of the actions that determine the displacement of the more or less permanent anticyclones it is doubtful whether an occasional coincidence could be accepted as sufficient evidence to establish a relation. Some meteorologists, we believe, consider anticyclones to be comparatively inert masses, and others, on the contrary, as sources of action. They are remarkably persistent in position and character, and their variation of position from one period to another in south-western Europe is closely related to the abnormalities of weather. Where theoretical opinions differ so largely it is almost certain that it will require twenty-five to fifty years' data at the least to test the relation between the Abyssinian rainfall and the position of the anticyclone in south-western Europe or the adjacent Atlantic.

NEW PHYSICAL AND ENGINEERING DEPARTMENTS OF THE UNIVERSITY OF EDINBURGH.

The new buildings for the natural philosophy (Prof. MacGregor) and engineering (Prof. Hudson Beare) departments of the University of Edinburgh were opened on October 16 by Dr. Andrew Carnegie in the presence of a large and influential gathering. The proceedings took place in the large lecture theatre of the natural philosophy department, and were presided over by the Chancellor, the Right Hon. A. J. Balfour. Part of an address entitled "A Plea for Science Teaching" delivered by Dr. Carnegie before declaring the buildings open was printed in last week's Nature (vol. lxxiv., p. 648).

The Chancellor then moved a vote of thanks to the benefactors. He was glad to have the opportunity of mentioning the work of the friends and admirers of the late Prof. Tait who had instituted a fund to encourage research, which he hoped would make these walls illustrious to all time. No more fitting tribute to Prof. Tait's memory could possibly have been contrived. Though Prof. Tait worked in what he could hardly call a laboratory, ill-equipped and wholly inadequate to the work of modern research, yet he left a name which for all time would be associated with the great development of physical knowledge which marked the last fifty years of the recent century—a movement which he believed would be conducted with ever increasing acceleration through the earlier years of the present century. He was glad also to have an opportunity of saying to Lord Elgin that the work he had done as chairman of the Carnegie Trust was a work for which he had earned the gratitude of every man interested in the fate of the Scottish universities and in the maintenance of the position which Scotland had held for more than 150 years in the world of learning. Proceeding, the Chancellor referred to Dr. Carnegie, whose munificent beneficence to many great causes, and so far as they were concerned especially to the Scottish universities, was known, and was destined to leave a permanent mark and do permanent good in Scotland.

Sir William Turner, in seconding the motion, referred to the great kindness of Sir Donald Currie, who, he said, had taken a great weight off his mind when he told him he need not be under any difficulty in finding the money to hand over to the municipality for the site on November 11 two years ago. He also desired to thank Sir John Jackson for his generous gifts, and stated that before long he hoped they would be in a position to receive from him a very handsome addition to the Tait memorial fund.

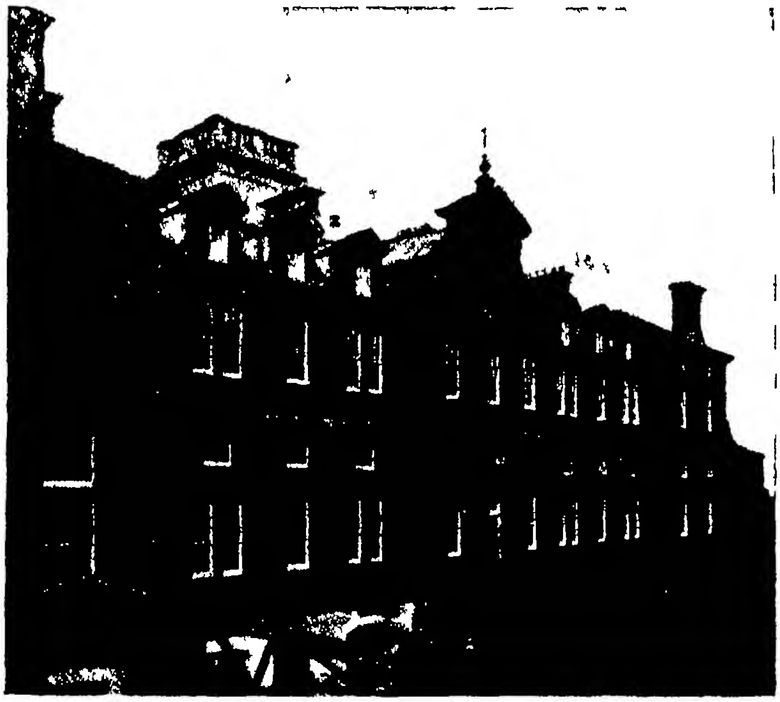

Fig. 1.—South front of new Natural Philosophy Buildings, University of Edinburgh.

Natural Philosophy Buildings.

The accompanying illustration (Fig. 1) shows the south front of this block of buildings. The building which has been transformed into a physical institute—the old surgical hospital of the infirmary—consisted of a main block 107 feet by 43 feet running nearly east and west, with wings at both ends 62 feet by 38 feet, and a block 71 feet by 51 feet running north towards the new engineering buildings, this north block including, at its junction with the main building, a tower 89 feet in height. The outer walls have been almost entirely utilised as they stood, with one important exception—on the southern side of the main building, by terracing the ground and piercing the lower part of the wall with large windows, the old dark basement rooms have been converted into lofty well-lighted laboratories. The interior has been largely reconstructed, and all the floors are now concrete, supported on cast and west steel girders.

The principal floor, entered directly from Drummond Street, contains the lecture theatre, apparatus rooms, library, professor's research rooms, &c. The lecture theatre, 45 feet long, 46 feet wide, and 32 feet in height, with seating accommodation for 250 students, is lit entirely from an opening in the roof, and is ventilated by an electric fan. The lecture table is 30 feet long, standing in an experimental area 15 feet wide; it is supplied with hot and cold water, high-pressure water, steam, gas, vacuum, air blast, oxygen, and a number of electric circuits, and a heliostat has been placed in a window of the apparatus room so as to send a beam of sunlight along it. Opening off the lecture theatre is a preparation room with the necessary work benches; this room contains also the main switchboard from which current will be distributed throughout the building from the town mains and from the accumulators. The apparatus room has a corridor entrance immediately opposite that of the preparation room; it is intended only for lecture apparatus. On the west side of the apparatus room provision has been made for a smaller lecture room, capable of accommodating about eighty students, and on the ground floor there is another small lecture room for the department of applied mathematics. The library and reading room is 37 feet by 29 feet, with a southern exposure, and opens off the entrance hall.

The upper floor and the ground floor are devoted to the laboratories and research rooms, the east wing of the upper floor is reserved for arts and science students, and the west wing for medical students The junior arts and science laboratory has accommodation for forty-five students, and is fitted with tables, benches, and wall apparatus for introductory experimental work, on one side is a long gallery for optical work The senior laboratory will accommodate forty students, and consists of three rooms for mechanical, thermal, and electrical work, two rooms for optical work, and two for sound Between these two sets of laboratories is a research room for the chief laboratory assistant, and adjoining them is a small workshop with benches lathe, glass-blowing table, &c

On the ground floor are the research rooms, at present only five are to be fitted up, the remainder will be equipped and brought into use as funds permit These rooms have firm concrete floors, have stone shelves built into the thick, solid walls, and are supplied with high- and low-pressure water, gas, electric currents, &c, and in certain of the rooms, by the use of copper and brass piping, and by other precautions, provision has been made for work with delicate electrical instruments On this floor are also the accumulator room, a large workshop and forge room, and a constant-temperature room

The tower, 89 feet in height, has been utilised for suspension of long wires, mercurial pressure-gauge and other purposes requiring considerable height, and, lastly, on the roof a floor space, 24 feet by 12 feet, has been arranged for open air experiments

Engineering Buildings

The accompanying illustration (Fig 2) shows the west end of the block of buildings for the engineering department

The building is Γ-shaped the head of the T facing west In the head of the T, on the ground floor, are provided large laboratories for the testing of materials (42 feet by 30 feet) and for hydraulics (51 feet by 30 feet) The first floor is devoted mainly to a laboratory for experimental work, which does not require heavy machinery (73 feet by 25 feet) On this floor are also a small lecture room, the departmental library, and the private rooms for the staff

The back block of the building is also divided into two floors—the lower forms the lecture theatre and the upper the drawing office The lecture theatre will seat about 120 students, and on the lecturer's table are all the needful appliances for experimental demonstrations, there being steam, gas, and electrical connections There are also the necessary appliances for darkening the room in order to allow of the free use of lantern demonstrations The drawing office is a fine room, about 45 feet square, lit entirely from the north and east, the roof being of the saw-tooth pattern, the floor space giving room for about sixty independent drawing tables Special rooms have also been set aside for blue-print work and photography

A workshop and heat laboratory (48 feet by 42 feet) has been provided for by roofing in and connecting to the main building a piece of ground lying in the north-east angle between the front and back blocks The workshop and laboratory contains examples of all the ordinary machine-tools gas-engines, steam-engines, and other plant for experimental research in connection with thermo-dynamics

The building is heated by hot water and by steam, an independent boiler house has been constructed for this purpose, with two large boilers

A considerable amount of additional apparatus has been installed in these new buildings The testing laboratory now contains a 100-ton Buckton machine, with the necessary electric motor, pump, and accumulator, a 60,000-lb Riehle machine, an Amsler 100-ton machine, specially designed for compression and bending work, and a complete installation for the testing of cements, mortars, &c

In connection with the hydraulic laboratory, a water tower has been constructed at the south-east corner of the building, at the top of this tower is a large cast-iron tank holding about 10 000 gallons, and giving a head of 65 feet above the floor-level of the laboratory The floor of the laboratory is on two different levels, on the upper level are placed the various turbines, water wheels and other hydraulic machines on which experimental investigations will be carried out The water discharged from these machines passes into one or other of three rectangular channels formed in the floor and the quantity is measured by allowing the water to pass over weirs The water then flows into one or other of two large rectangular tanks, each 11 feet square by 5 feet deep, sunk below the lower floor-level of the laboratory, where it is measured again by floats, with rods moving in front of carefully graduated vertical scales From these lower measuring tanks the water is lifted by an electrically driven 20 h p centrifugal pump back to the storage tank in the water tower The hydraulic equipment includes a Venturi meter and other forms of meters and a considerable amount of other apparatus for experimental work

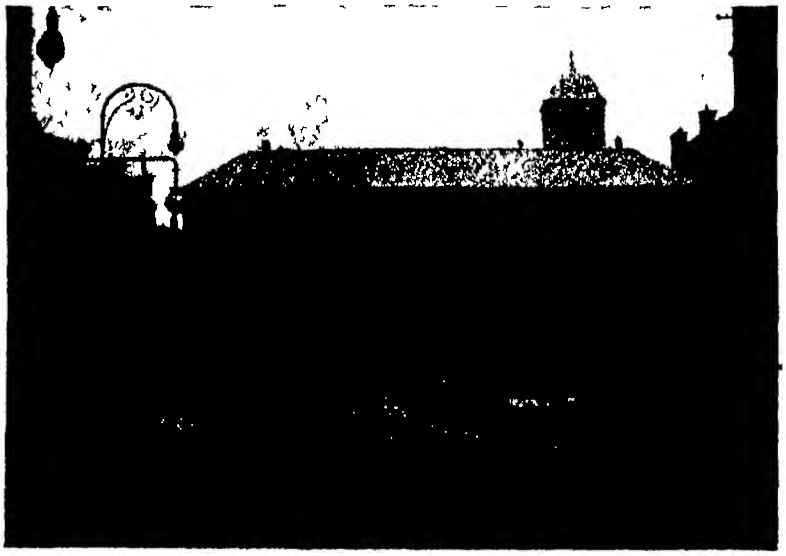

FIG 2 —Entrance and West Front of new Engineering Department University of Edinburgh

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD —The geographical scholarship for 1906 has been awarded to Mr N de Lancey Davis, Jesus College

Mr J A Brown, New College, has been appointed demonstrator in the laboratory of the Wykeham professor of physics

The following elections have been made at Jesus College —to scholarships in natural science, G I Wishart Wilson's Grammar School, London, S E, and H F Jones, County School, Towyn, to exhibitions in natural science R Atkin Nottingham High School, and A D Phoenix, Grove Park School, Wrexham

CAMBRIDGE —The following recommendations contained in a report of the special board for mathematics on the mathematical tripos, received the sanction of the Senate at a congregation held on October 25 —(1) A student may be a candidate for part 1 of the mathematical tripos

at a date not earlier than his second term and not later than his seventh term (2) A student who fails to obtain honours in part i of the mathematical tripos may be a candidate on a second occasion, provided he then be otherwise qualified (3) The examination for part i shall comprise the subjects in the schedule annexed to the report (4) The list of successful candidates in part i shall be arranged in three classes, the names in each class to be arranged alphabetically (5) The examination for part ii shall comprise the subjects in the Schedules A and B annexed to the report, together with certain questions partly on the subjects of the schedule for part i (6) The list of successful candidates in part ii shall be arranged in the three classes of wranglers, senior optimes, and junior optimes, the names in each class to be arranged alphabetically (7) In the examination for part ii the class in which a candidate is placed shall be in general determined by his performance in the papers on the subjects of Schedule A, a mark of distinction and a mark of proficiency being awarded to those candidates who acquit themselves with sufficient credit in the subjects of Schedule B

The Senate will be asked on Saturday, November 3, to assign a site in Free School Lane for the proposed extension of the Cavendish Laboratory, and to appoint a syndicate to consider the assignment of a site for the extension of the chemical laboratory Lord Rayleigh's munificent gift of 5000*l* out of the Nobel prize will go toward the cost of the new building for physics It will be remembered that the balance of the prize was given by Lord Rayleigh to the University library fund The extension of the chemical laboratory is called for because Gonville and Caius College are proposing to close their chemical laboratory at the end of the academic year

THE Cairo correspondent of the *Times* states that considerable interest has been aroused there by a proposal to found a national university, modelled on European lines, and independent both of the Ministry of Public Instruction and of the mediæval foundation of Al Azhar A committee, which includes the leaders of the progressive Mohammedan school of thought, has been formed to draft a programme of courses and to raise the sum of at least £E500,000 which will be required to make the university a reality In an appeal for public support, Kassim Bey and the other promoters of the scheme outline its features The courses of the proposed foundation are to be literary and scientific, open to all without distinction of nationality or creed Diplomas will be granted to students fulfilling conditions of attendance and passing the requisite examinations and no attempt will be made at the outset to encroach upon the primary, secondary, and technical instruction imparted by the various Government schools

LORD ROSEBERY, as Chancellor of the University of London, on October 26 performed the ceremony of opening the library of the University After expressing the gratitude of the University to the Goldsmiths' Company, which spent 15,000*l* in securing and supplementing Prof Foxwell's library, and explaining the growth of the University library as a whole, Lord Rosebery, among many other subjects of wide interest, spoke of the functions of a library He said there is no greater misconception of a library than to think that it can take the place of a university "No doubt a student must be fed by books, it is impossible for the student to proceed far without books, but I will urge a further consideration which I should think the experience of those of my age who are present will tend to confirm—that the mere habit of reading, and often of reading copiously, without any exercise or output for their knowledge, is injurious rather than beneficial to the mind It is apt to produce a condition of mental debility, if not of mental paralysis I hope that no students will ever believe that the library of this University is intended as more than a staff and an assistance, and not in any degree as the object of their training at this University"

MR HALDANE, as is appropriate to the president of the British Science Guild, avails himself of every opportunity to insist upon the value of knowledge and of scientific habits of thought in every sphere of human activity Distributing the prizes and certificates to the students of Birkbeck College on October 26, Mr Haldane said there is a danger which is inseparable from a college such as the Birkbeck College It is largely attended by those who have their bread to win, and whose main concern must be to win it and to win the leisure for learning. The temptation becomes very strong in such a case to look upon learning as being what the Germans call a *brotwissenschaft*—a scientific means of increasing the opportunities for earning a living That is a very cramping view, and one fatal to the higher learning But it is the higher learning that pays in these times—not the learning which is a means to an end, but the learning which is an end in itself Learning for learning's sake, that is the key to a career Not every person who has learning is necessarily successful in his career, but, other things being equal, the man who is penetrated with the spirit of the scholar has a far better chance in the race of life than the man who is not so penetrated What is true of individuals is true of nations A few years ago Japan was reckoned with those who were not civilised To-day, by singleness of purpose, by concentration upon science, by the dominant purpose of the nation to fashion its national character according to the highest ideas, Japan has leapt, at a bound almost, into the front rank Germany, too, has gone forward stride after stride on the basis of scientific re-organisation These are lessons that we do well to bear in mind

A NEW hall and buildings in connection with University College, Reading, were opened on October 27 by Mr Haldane, Secretary of State for War As has been noted in these columns, the new site was secured as a gift of Mr. Alfred Palmer, and the new buildings now opened bring the council an important step nearer the completion of its scheme for a fully equipped college The principal feature of the new buildings is the great hall in which the ceremony took place The science laboratories and art studios consist of seven separate buildings, and accommodation is provided for theoretical and practical work in biology, agriculture, physics, chemistry, and geography Mr Haldane, in the course of his speech declaring the new hall open, said —"It is impossible to set up technical education successfully on anything but the broadest basis of culture It is distressing to consider, not only how small a part the State has played in higher education in this country, but how misplaced its intervention at times has been The present Government proposes to spend an extra 1,000,000*l* a year on elementary instruction, and the late Ministry spent more than that sum additionally for the same purpose, but these payments arose out of controversies which had little to do with education The Government is doing something for the higher teaching, but its capacity is limited by what the people will allow. There is already a great awakening in this country with reference to higher instruction, but it is due to private donors far more than to the public generally The War Department wants several things dependent on education. It desires a great reserve of officers, and one thing that it is considering at this moment is how to get the universities and university colleges to assist it A great misfortune has come to the Army of late through the revelation, in relation to the South African War, of an altogether inadequate organisation and training, inadequate to cope with the great business of supply in time of war and the period following war Supply is a science by itself, which requires high training if the country is not to be victimised by contractors and everything is to be placed where it is needed The Army has organised its General Staff, which requires officers with the highest class of instruction for strategy, tactics, and general command This is one side of military education, but there is an administrative side also, and up to now no steps have been taken to give the highest education to administrative officers The Government has decided to train a school of administrative officers up to the high level that it is trying to attain for staff officers A certain number of officers will study at the London School of Economics, and it is hoped that they will form the nucleus of an administrative staff as capable as the general staff whether of our Army or any other

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, October 18 —Sir W Ramsay, K C B, F.R.S., in the chair —The Longstaff medal was presented to Prof. W Noël Hartley, F R S, of Dublin, for his researches in spectrochemistry —The description and spectrographic analysis of a meteorite stone W N **Hartley** This stony meteorite was seen to fall in the Kangra Valley, Northern Punjaub, in 1897 The principal constituents of the metallic portion are iron, nickel, cobalt, and chromium, with small quantities of copper, lead, silver, and gallium Manganese, calcium, potassium, and sodium are only present in minute proportions —Malacone, a silicate of zirconium containing argon and helium S **Kitchin** and W G **Winterson.** This mineral, found at Hitteroe and Arendal, Norway, is radio-active, and gives off a mixture of helium and argon when heated The analysis, discounting ferric oxide, uranium oxide, &c, points to the ratio $3ZrO_2 \cdot 2SiO_2$ between the zirconia and the silica —The relationship of colour and fluorescence to constitution, part i, the condensation products of mellitic and pyromellitic acid with resorcinol O **Silberrad** One of the chief interests of this work lies in its bearing on the quinone theory of the structure of the phthaleins Many of the compounds described do not admit of formulation on the quinone type, but are nevertheless intense colouring matters, and strongly fluorescent —Separation of αα- and ββ-dimethyladipic acids A W **Crossley** and Miss N **Renouf** —Action of alcoholic potassium hydroxide on 3-bromo-1 1-dimethylhexahydrobenzene A W **Crossley** and Miss N **Renouf** —The conversion of morphine and codeine into optical isomerides, preliminary communication F H **Lees** and F **Tutin.** The facts obtained permit of the following conclusions respecting the constitution of morphine —(1) the isomeric codeines are the result of the racemisation of two asymmetric carbon atoms in a molecule which must necessarily contain a third asymmetric system, (2) the carbon atoms which undergo racemisation are most probably those in the reduced phenanthrene nucleus to which the alcoholic hydroxyl group and the nitrogen atom are respectively attached, (3) The possible isomeric codeines must be represented by the configurations $++-$, $+--$, $-+-$, $---$ —The aminodicarboxylic acid derived from pinene W A **Tilden** and D F **Blyther** Details are given for the preparation of the acid and its hydrochloride, nitrate, acid oxalate, copper salt, ethyl ester and its hydrochloride, and the acetyl derivative —The preparation and properties of dihydropinylamine (pinocamphylamine) W A **Tilden** and F G **Shepheard** Dihydropinylamine is the chief product of the reduction of nitrosopinene by means of boiling amyl alcohol and sodium The hydrochloride, platinichloride picrate, nitrate, oxalate, also the acetyl and benzoyl derivatives and the carbamide, have been prepared and analysed —Determination of nitrates F S **Sinnatt.** It is shown that Knecht and Hibbert's method for the estimation of picric acid (*Ber*, 1903, xxxvi, 1549) may be applied to the estimation of nitrates —The nature of ammoniacal copper solutions H M **Dawson.** The experimental data obtained indicate the existence in solution of a dissociating complex compound containing four molecules of ammonia per atom of copper —The colouring matters of the stilbene group, part iii A G **Green** and P F **Crosland.** It is shown that all the dyestuffs of the stilbene series are true azo-compounds Their chromophor being an azo-group, their dyeing properties are now satisfactorily explained They differ however, from most other azo-dyestuffs in the entire absence of auxochrome groups —Interaction of succinic acid and potassium dichromate Note on a black modification of chromium sesquioxide F A **Werner.** When a mixture of finely powdered potassium dichromate (1 mol) and succinic acid (6 mols) is heated, a compound having the composition $Cr_4(C_4H_4O_4)_5\,7H_2O$ is formed which has not the properties of a chromo-organic acid The chromium hydroxide produced from it by decomposition with sodium hydroxide leaves a jet-black modification of the sesquioxide after ignition —Derivatives of polyvalent iodine The action of chlorine on organic iodo-derivatives, including the sulphonium and tetrasubstituted ammonium iodides F A **Werner** —The so-called "benzidine chromate" and allied substances J **Moir** This substance, which resembles cœrulignone, results on mixing solutions of benzidine and chromium trioxide It is the chromate, not of benzidine, but of a complex oxidation product of the latter —New derivatives of diphenol (4 4′-dihydroxydiphenol) J **Moir.** By the sulphonation of diphenol the author has prepared the 3 3′-disulphonic acid, the 3 5 3′ trisulphonic acid, and the 3 5 3′ 5′-tetrasulphonic acid —The interaction of the alkyl sulphates with the nitrites of the alkali metals and metals of the alkaline earths P C **Rây** and P **Neogi.** By the interaction of the sodium, potassium, barium, and calcium salts of ethyl sulphuric acid and the nitrites of the alkali metals and metals of the alkaline earths, both ethyl nitrite and nitroethane were formed —The electrolytic preparation of dialkyldisulphides Preliminary note T S **Price** and D F **Twiss.** By the electrolysis of a concentrated aqueous solution of ethyl sodium thiosulphate commonly known as Bunte's salt, diethyldisulphide is formed at the anode Similar results were obtained by electrolysing solutions of benzyl sodium thiosulphate, dibenzyldisulphide being produced —The direct union of carbon and hydrogen at high temperatures J N **Pring** and R S **Hutton.**—The action of nitrogen sulphide on certain metallic chlorides O C M **Davis** When nitrogen sulphide dissolved in dry chloroform is added to the tetrachlorides of tin and titanium, the pentachlorides of antimony and molybdenum, and also tungsten hexachloride dissolved in the same solvent, interaction readily takes place The compounds formed are represented by the formulæ $SnCl_4,2N_4S_4$, $SbCl_5,N_4S_4$, $MoCl_5,N_4S_4$, $WoCl_4\,N_4S_4$, and Ti_2Cl_8,N_4S_4 —The determination of halogen J **Moir**

PARIS

Academy of Sciences, October 22 —M H Poincaré in the chair —The work stored up in the trochoidal wave Émile **Bertin** —Distillation and desiccation in a vacuum with the aid of low temperatures MM **d'Arsonval** and **Bordas** The vapours given off pass into a condensation tube cooled either with liquid air or a mixture of solid carbon dioxide and acetone, according to the vacuum required After a preliminary exhaustion with a water-pump, the exhaustion is completed by a tube filled with charcoal immersed in liquid air or acetone and carbon acid snow, a Crookes's tube being used as a manometer The vacuum is maintained by the charcoal tube in spite of any slight leakages through the connections A diagram of the apparatus is given, together with full details for its use The following advantages are claimed for the method —the evaporated liquid can be weighed directly the evaporation taking place at the ordinary temperature and in the absence of air the dried substance is obtained without alteration, and the time required for the whole operation is much reduced Thus to obtain the dry residue from wine which required three days when evaporated in a vacuum by the ordinary method, three hours are sufficient – Contribution to the study of the calorific emission of the sun G **Millochau** and C **Féry** Details are given of the calibration of the apparatus described in a previous paper Basing the constant of the instrument on the calibration with an electric furnace, the temperature of which was taken as 1673° absolute, and correcting for atmospheric absorption, the temperature of the sun as given by observations at the summit of Mt Blanc is 5620° C —Researches on atmospheric lines Milan **Štefánik** By the application of the method of coloured screens the author has been able to study the telluric lines in the infra red A description is given of the instruments employed, observations being made at the Observatory of Meudon, Chamonix Grands-Mulets, and the summit of Mt Blanc —Isothermal surfaces of the first class L **Raffy** —Isothermal surfaces R **Rothe** —The conditions of complete integrability of certain differential systems M **Riquier** —The liquefaction of air by expansion with external work Georges **Claude** —A safety apparatus for providing against accidental sparks in the effects of wire less telegraphy Édouard **Branly** —The aurora borealis A reply to M Stormer P **Villard** —The existence of chloride of bromine Paul **Lebeau** The author has repeated the experiments of earlier workers under varying

conditions on the so-called chloride of bromine, and comes to the conclusion that no such compound really exists The crystals which can be obtained by cooling sufficiently a solution of bromine in liquefied chlorine have a composition depending on the temperature at which they are formed and are mixed crystals of the two halogens — Protoxide of cæsium E **Rengade**. It is possible to prepare the oxide of cæsium Cs_2O in a pure and well-crystallised condition by admitting a limited quantity of oxygen to a weighed amount of the metal When about two thirds the amount of oxygen necessary to form the Cs_2O has been admitted, the excess of the metal is slowly distilled off in a vacuum at 200° C The oxide remains in the form of orange-red crystals, reacting violently with water, and decomposing at about 500° C in contact with silver, and in the cold in the presence of liquefied ammonia the latter giving a mixture of the amide and hydrate of cæsium —*The pure alloys of tungsten and manganese, and* the preparation of tungsten G **Arrivaut**. In the reduction by aluminium a suitably high temperature of reaction is obtained by using Mn_3O_4, WO_3, MnO_2, and WO_2 in varying proportions Manganese-tungsten alloys can be prepared containing from 12 per cent to 60 per cent of tungsten By preparing an ingot containing 45 per cent of tungsten and submitting this to the action of hydrochloric acid, the residue was nearly pure tungsten 99 5 per cent — The products of condensation of acetylenic esters with amines Ch **Moureu** and I **Lazennec** The products of the condensation of the acetylenic esters $R—C \equiv C—CO_2R'$ with amines are non-basic bodies, easily hydrolysed by acids Hydrolysis regenerates the amine with formation of the ketonic ester $R—CO—CH_2—CO_2R'$ The reaction furnishes a new method of passing from the acetylenic esters to the β-ketonic esters —The atomic weight of dysprosium G **Urbain** and M **Demenitroux** A set of determinations carried out on the products of different fractions gave 162 54 (O = 16) as a mean of twelve very concordant results —The presence of formol in certain foods G **Perrier** By applying the very sensitive reaction proposed by Voisenet for the detection of minimal proportions of formol, the author has proved the presence of this substance in various articles of food the formaldehyde arising from the mode of preparation and not having been specially added In view of these results the author discusses the advisability of altering the existing law which absolutely prohibits the presence of formaldehyde in food substituting a maximum limit The azo colouring matters heat of combustion and constitutional formulæ P **Lemoult**.—The liquid crystals of cholesteryl propionate Fred **Wallerant**.—The action of copper salts on the germination of Penicillium M **Le Renard** — The variations of assimilation with light and temperature W **Lubimenko** — The swimming mechanism of *P maximus* Fred **Vles**.—*Mesoglicola Delagei*, a parasite of *Corynactis viridis* A **Quidor** —The units of the hæmatozoa of paludism M **Thiroux** The Dolichopodidæ of amber from the Baltic Fernand **Meunier**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 1

ROYAL SOCIETY at 4 30 —On Intravascular Coagulation in Albinoes and *Pigmented Animals and on the Behaviour of the Nucleo proteids of* Testes in Solution in the Production of Intravascular Coagulation G P Mudge —Nitrification of Sewage Dr G Reid —A General Consideration of the Subaërial and Freshwater Algal Flora of Ceylon Dr F E Fritsch —The Anæsthetic and Lethal Quantity of Chloroform in the Blood of Animals Dr G A Buckmaster and J A Gardner

CHEMICAL SOCIETY, at 8 30.—A Development of the Atomic Theory which correlates Chemical and Crystalline Structure and leads to a Demonstration of the Nature of Valency W Barlow and W J Pope —The Explosive Combustion of Hydrocarbons II W A Bone, J Drugman and G W Andrew - Contributions to the Theory of Solutions (1) The Nature of the Molecular Arrangement in Aqueous Mixtures of the Lower Alcohols and Acids of the Paraffin Series, (2) Molecular Complexity in the Liquid State (3) Theory of the Intermiscibility of Liquids J Holmes.—The Hydrolysis of Nitro cellulose and Nitro-glycerol O Silberrad and R C Farmer —The Determination of the Rate of Chemical Change by Measurement of Gases Evolved F E E Lamplough — Experiments on the Synthesis of the Terpenes Part IX., The Preparation of δ Ketohexahydrobenzoic Acid (δ-Keto*cyclo*hexanecarboxylic Acid) and of γ-Keto*cyclo*pentanecarboxylic Acid F W Kay and W H Perkin, jun —Experiments on the Synthesis of the Terpenes, Part X, Synthesis of Δ *m*-Menthenol (8) and of Carvestrene W H Perkin, jun, and G Tattersall - Some Derivatives of Catechol, Pyrogallol Benzophenone and of Other Substances allied to the Natural Colouring Matters W H Perkin, jun, and C Weizmann

LINNEAN SOCIETY at 8 —The Structure of Bamboo Leaves Sir Dietrich Brandis K C I E., F R S —On a Collection of Crustacea Decapoda and Stomatopoda, chiefly from the Inland Sea of Japan, with Descriptions of New Species Dr J G de Man.—On *Hesterella caespitosa*, Hook. f., with Remarks on its Systematic Position Prof A J. Ewart.—*Exhibitions* Young Plaice Hatched and Reared in Captivity the President.—Abnormal Specimens of *Equisetum Telmateia*, Ehrh George Talbot.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8 —Bridge Work Design P J Waldram

FRIDAY NOVEMBER 2

GEOLOGISTS' ASSOCIATION, at 8 —Conversazione

MONDAY, NOVEMBER 5

SOCIOLOGICAL SOCIETY, at 8 —Psychological Factors in Social Transmission Dr J W Slaughter

LONDON INSTITUTION, at 5.—Earthquakes and Volcanoes Sir Robert Ball, F R S

SOCIETY OF CHEMICAL INDUSTRY, at 8 —The Advantages of Investigating the Unlikely Sir William Ramsay, K C.B., F R S.

TUESDAY, NOVEMBER 6.

INSTITUTION OF CIVIL ENGINEERS, at 8 —Address by the President, Sir Alexander B W Kennedy, and Presentation of Medals and Prizes Awarded by the Council

WEDNESDAY, NOVEMBER 7

ENTOMOLOGICAL SOCIETY, at 8 —A Permanent Record of British Moths in their Attitude of Rest A H Hamm.

GEOLOGICAL SOCIETY, at 8 —On the Upper Carboniferous Rocks of West Devon and North Cornwall E. A Newell Arber —The Titaniferous Basalts of the Western Mediterranean H S Washington

SOCIETY OF PUBLIC ANALYSTS, at 8 —The Analyst and the Medical Man Dr F Gowland Hopkins, F R S

THURSDAY NOVEMBER 8

ROYAL SOCIETY, at 4 30 —*Probable Papers* Note on the Continuous Rays observed in the Spark Spectra of Metalloids and some Metals Prof W N Hartley F R S —The Composition of Thorianite, and the Relative Radio-activity of its Constituents Dr E H Büchner —On a Compensated Micro-manometer B J P Roberts —Experimental Investigation as to the Dependence of Gravity on Temperature L Southerns.—A Numerical Examination of the Optical Properties of Thin Metallic Plates Prof R C. Maclaurin

MATHEMATICAL SOCIETY, at 5 30.—Annual General Meeting —Presidential Address Partial Differential Equations, some Criticisms and some Suggestions Prof A R Forsyth —Harmonic Expansions of Functions of Two Variables Prof A C Dixon —The General Solution of Laplace's Equation in *n* Dimensions G N Watson — On Sub-groups of a Finite Abelian Group H Hilton —On Bäcklund's Transformation and the Partial Differential Equation $r = F(x, y, s)$.

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Presentation of Premiums awarded for Papers Read or Published during 190 -06 —Inaugural Address by the President, Dr R T Glazebrook, F R S

FRIDAY, NOVEMBER 9

ROYAL ASTRONOMICAL SOCIETY, at 5

PHYSICAL SOCIETY, at 8 —Exhibition and Description of Experiments Suitable for Students in a Physics Laboratory G F C Searle

MALACOLOGICAL SOCIETY, at 8 —Description of a New Species of Calliostoma from S Formosa E A Smith, I S O —Description of a New Sub-genus and Species of Alycæus from Ke lan tan. H B Preston —*Description of Six New Species of Shells and of Leptomyx lintea* Hutton from New Zealand H Suter —Descriptions of some Tertiary Shells from New Zealand H Suter

CONTENTS

THURSDAY, NOVEMBER 8, 1906

SCIENCE AND FOLLY

The Seven Follies of Science a Popular Account of the most famous Scientific Impossibilities and the Attempts which have been Made to Solve Them By John Phin Pp viii + 178 (London Archibald Constable and Co, Ltd, 1906) Price 5s net

THESE "Follies" are the squaring of the circle, the duplication of the cube, the trisection of an angle, perpetual motion the transmutation of metals the fixation of mercury, and the elixir of life, we miss from this list the flattening of the earth The author is an American, he writes for ordinary readers, and makes his subject interesting, he seems to make no mistakes He dwells at much greater length upon the first and fourth of the follies than the rest In addition to these seven classical ones he gives an account of four others perpetual lamps, the alkahest or universal solvent, palingenesy (the revival of a plant or animal from its ashes), and the powder of sympathy He adds a division on the fourth dimension of space and some paradoxes, micrographv illusions of the senses, and two tricks The book finishes with an account of some arithmetical problems and the fulcrum of Archimedes which are probably "curious" to the ordinary reader

Readers of NATURE and not merely ordinary readers, may spend a pleasant hour or two in looking through this book reflecting on the follies, not of scientific persons, but of those persons supposed to be cultured who are ignorant of physical science in an age when applications of the principles of physical science are transforming the world Our greatest legislators and writers and divines are no better guarded mentally from tricksters than their ancestors We know that a new Mahomet might have just as much success with cultured and uncultured persons in the twentieth as in the seventh century, but it is startling to find that a new Caghostro might probably be even more successful in the twentieth than in the eighteenth century A scientific man does not deny the possibility of almost any miracle, he only says that it is extremely improbable He admits that man is probably limited in his senses and faculties, and that all his physical laws are mere analogies, that real comprehension of the universe is altogether out of the question These admissions have become known now to unscientific persons, and no Swedenborgian was more ready to take the cock-and-bull statements of his master on trust than 99 per cent of newspaper readers and writers at the present time are willing to accept absurd stories as true A cultured person says that of course a perpetual motion is impossible, but he invests his money in a company which promotes something which is really meant to create energy He scorns the Middle Age idea that a sympathetic powder applied to a dagger will cure a distant wounded person but although he has been to a public school he is a profound believer in Christian science

Few men probably receive more communications from earth flatteners and circle squarers and arc trisectors than the present writer When he receives one he does not feel pleased, and yet it ought to be pleasant to think that there are so many men in the world who refuse to accept dogma A *crank* is defined as a man who cannot be turned These men are all cranks, at all events we have never succeeded in convincing one of them that he was wrong The usually accepted axioms, definitions, and technical terms are not for them When they use a term sometimes evidently in two different senses in the same syllogism it is impossible to find exactly what they mean by it If Mr Phin had had his reviewer's experience, he would have greatly added to the size of his book by referring to many parts of physics where men are just as unwilling now to accept authority as the men of whom he writes, and he would have pointed out that our real difficulty is with the men who are partly right men who think they have a new idea and try to explain it in unscientific language, and as they do so denounce the orthodox beliefs which they have been unable to understand

From many follies the common people have been saved for ever by the engineers the men who apply science In this twentieth century it is difficult to believe in sympathetic wax images and powders and the other things cherished by our ancestors who executed witches, because miraculous railway trains and telegraphs and telephones and thousands of things to be seen in every shop on every street on every road are known to be explainable in reasonable ways To believe now in the evil eye or devil possession ghosts haunted houses or the powers of the esoteric Buddhist it is necessary to have a very special kind of mental power and of education and environment It may be that only one in every 100,000 of the inhabitants of these islands is capable of snatching the fearful joy which accompanies such beliefs

As already said, we think that the author of this book makes no mistakes, but if he had known more he might have made the book a much larger one with advantage, and we cannot help thinking that he is not well read in the delightful memoirs of the sixteenth century, when witchcraft had a really good time Then as to a fourth or twentieth dimension in space, he gives practically no information to the expectant reader in this division of his work, yet there is probably no subject on which the cultured reader of the present day desires instruction more (perhaps excepting *radium*) A man may get some knowledge of Greek or Japanese literature without knowing the Greek or Japanese languages, and so the cultivated person hopes to get scientific ideas without knowing the language of science The author hardly tries to hide his own ignorance of this part of his subject and here, as everywhere else, he gives only what he himself feels sure that he understands He writes for the man in the street and we can give no higher praise than to say that the man in the street will understand him

J P

in the cotton gin has been made since it was introduced"—more than 100 years ago—and an authority is quoted as saying that "the saw gin actually wastes or destroys over 6 per cent. of all the cotton raised in the Southern States, meaning the destruction each year of nearly 40,000,000 dollars worth of property belonging to the farmers of the South." By other quoted authorities it is stated that "the saw gin destroys over 40 per cent. of the initial strength of the cotton fibre." It is also pointed out that, besides this waste, cotton can only be pressed to 14 lb. per cubic foot at the ginneries.

"A fortune," say the authors, "awaits the man who will invent a compress requiring small horse-power so that the bales, with one handling at the gin, may be compressed tightly enough for export purposes, just as a fortune awaits the man who will invent a roller gin for upland cotton by which the present waste and the barbarous laceration of the fibre may be obviated."

Such a statement is strong testimony of the authors' lack of knowledge of cotton affairs. Do they not know that there is a press in their own country which can be affixed to a gin and turn out a bale compressed to 35 lb. per cubic foot, and that it only takes 5 h.p. to drive it? Do they not know that in England gins are built which neither cut the cotton nor weaken the fibre, whether used on the long staple of Egypt or the short staple of India? Do they not know that American trusts are trying to defeat one of these longed for improvements, and American tariffs prohibit the other?

The remarks about baling are specially interesting as coming *from friends of the farmer*. After observing that "like the gin, the baling press has been materially improved in rapidity and in efficiency" (they told us on a previous page that no noteworthy improvement to the gin had been made since it was introduced, and that the old horse-driven gin did better work than the modern steam-power gin), they remark that "as a rule the American bale is not prepared with such care as its importance demands"; that the covering is torn, allowing the lint to drop out; that on bringing it back from the gin the farmer puts it under the apple tree or in the barn lot, or in some open, exposed place, "where rain and dust attack and damage it, and even pigs are allowed access to it on which to clean their muddy backs."

After making such a charge against the business capacities of the cotton farmer, is it not stretching a point to ask us to believe that these people who so mismanage their own business can by combination regulate the buying and selling of cotton on better or more economical lines than on the old law of supply and demand?

"Cotton" is very well printed, its illustrations are excellent, but from its numerous examples of bad English, the rhetorical extravagances indulged in by the authors, and the narrow views they take of political economy as affecting nation and nation, we are afraid their chances of being accepted as authoritative contributors to human knowledge are greatly jeopardised.

BOTANICAL DICTIONARIES.

(1) *Illustriertes Handwörterbuch der Botanik.* By Several Authors, and with the collaboration of Dr. O. Porsch and C. K. Schneider. Pp. vii+690, with 341 figures. (Leipzig: Engelmann, 1905.) Price 16s. net.

(2) *Dizionario di Botanica Generale.* By Dr. Guglielmo Bilancioni. Manuali Hoepli. Pp. xx+926. (Milan: U. Hoepli, 1906.) Price L10.

(1) IT would be an interesting question to discuss in its technical connections what are the differences between a glossary, a dictionary, and an encyclopædia of botany, but space will not allow of that, and we may pass on to say that this heavy book, typically German and written by Germans for Germans, stands in sharp contrast, with its unequal paragraphs—for instance, more than two pages and a half are devoted to *Drusen*, none to *Zelle*, and only half a page to *Zell-kern*—to the light and neat English "Glossary of Botanic Terms" of our own countryman Mr. Daydon Jackson.

The authors admit that the book has been designed to exclude antiquated terms on the one hand, and the most modern terms of the English-American and French literature on the other; they anticipate the question "How are we to draw the line?" and have decided that all purely descriptive expressions shall be excluded. But what are we to say to a "Handwörterbuch" from which all terms belonging to biochemistry and micro-technique, &c., except a few arbitrarily selected general terms, such as "swelling," "fermentation," "catalysis," "turgescence," &c., are excluded?

That the book contains an enormous amount of carefully collected information is sufficiently guaranteed by the names of the collaborators, but it is not a dictionary in the true sense of the word, and it is a very incomplete encyclopædia. The illustrations are good, but the majority of them are old and well-worn friends transferred bodily from the text-books of Sachs, De Bary, Frank, and others. To the ordinary student in this country the book can have little value; to the expert and experienced investigator it will have sufficient attractions for him to place it on his shelves. Of course the position it may be accorded in Germany, for the German student, is another matter with which we have nothing to do.

(2) Here we have a neatly-got-up book far more in accordance with the idea of a dictionary, though even here some of the paragraphs are too long and drawn out in the form of encyclopædic articles.

The preface begins "Vi fu chi affermò che il più interressante di tutti i libri è un dizionario." This may be so, in spite of the story, apparently unknown to the author, of the Scotchman who was found steadily perusing a dictionary from cover to cover with the sole complaint that the matter of the story seemed somewhat disconnected. A useful feature of the book is an appendix of biographical sketches of botanists, living and dead; this is necessarily very short and incomplete. There are no illustrations.

Taking these two works together, they may be recommended to the expert botanist, as said, as books of reference in cases where he wishes rapidly to extend his definition of special terms.

OUR BOOK SHELF

First Steps in the Calculus. By A. F. van der Heyden. Pp. vi+216. (London: Edward Arnold, 1906.) Price 3s.

THE modest claim expressed by the author in his preface, in the hope "that a step in the right direction has been taken towards producing a text-book suitable for an ordinary class in a Secondary Day School," is a claim which it would be impossible to deny. Experience has shown that geometrical illustrations, such as those on pp. 32–34, 45, and 96, are actually of great help to beginners, and we quite agree with the author that complicated theorems, such as Taylor's expansion (when applied to any but rational integral functions), should not be taken too early. The introduction (p. 93) of Lodge's treatment of the connection between integration and summation would be good if the step where the assumption is made were clearly pointed out. But there are many points which the author might have considered more fully before issuing the book. While the sine and cosine are properly differentiated it is surprising to find such a clumsy method employed for the tangent. In order to differentiate a power the beginner is required to swallow the usual series of terms which vanish in the limit instead of treating the power as a product.

In one or two places, in putting the chord of a curve equal to the corresponding arc, a line of explanation or even a reference number, would have made things much clearer. The introduction of e as early as chapter vi. is no doubt in accordance with traditions, but it is a pity to defer the study of the calculus until the text-books in algebra referred to for a discussion of exponential series have been read. Rational integral functions with applications to geometry and physics, afford plenty of material for the beginner. Lastly, the questions in examples ix. are very important indeed, but they give difficulty to many students who can hardly be described as beginners. The general conclusion is that the book would be more correctly described by a title which did not suggest something so *very* elementary. It is well suited for the class-room.

A Manual of Hydraulics. By R. Busquet. Translated by A. H. Peake. Pp. viii+312. (London: Edward Arnold, 1906.) Price 7s. 6d. net.

THIS book is a translation of a French treatise on hydraulics by Prof. Busquet, of the École industrielle de Lyon. It claims to be a text-book of applied hydraulics in which complete technical theories and all useful calculations for the erection of hydraulic plant are presented. The translator appears to have done his work well and to have given the meaning of the author in English terms and phrases. While the same arithmetical methods used in the original have been adhered to, the dimensions have been changed into ordinary British units, and the constants given in the formulæ have been modified to suit the change. The first three chapters deal with the elementary principles of the flow of water in open channels and pipes, and the last chapter with the flow over weirs. These subjects are dealt with in a simple and practical way. They do not, however, contain any information that is not to be found in English text-books on the same subject.

The fourth chapter, which occupies about half the book, is devoted to the theory and description of hydraulic motors and engines used to transform the energy contained in a head of water into mechanical work. The use of waterfalls hitherto has been limited, because the application of the energy could only be used locally, but since electricity has come into use for the transmission of power to great distances, water has assumed a new and increased value as an economical source for the production of power, and the construction of hydraulic installations is increasing at a rapid rate. The use of water-power and the machinery required to adapt it to commercial use have received very little attention from the authors of modern English and American treatises on hydraulics.

The writer does not know of any book that deals with this subject in so practical a way as the one under notice. The several kinds of water-wheels in use are described and illustrated, and their theoretical and useful value demonstrated. Turbines, which are now being largely used for the distribution of water-power, are freely dealt with, and the merits of the different forms of this machine discussed. The book is calculated to be of service both to students of practical hydraulics and to those engaged in designing and carrying out works for the utilisation of water-power.

Guide to the Principal Families of Flowering Plants. (After Engler's System.) By J. Adams. Pp. iv+40. (Dublin: Sealy, Bryers and Walker, 1906.) Price 1s. net.

A CONVENIENT summary for determining the orders of flowering plants is a much required desideratum. The difficulties in compiling such a summary are very great, not the least being due to the impossibility of defining the limits in certain cases between allied orders. Mr. Adams has not attempted such details, preferring to leave out a large number of orders and to sacrifice difficult distinctions to brevity and general utility. With regard to the statement that the book is after Engler's system, this applies only to the names of the orders, the method of separation is purely artificial. Thus in the Archichlamydeæ parasites and insectivorous plants are first eliminated, then consideration of the vegetative organs provides the next stages in differentiation. So far as practical tests have been applied with a few orders, the tables have given quite satisfactory results.

The Extra Pharmacopœia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and W. Wynn Westcott. Twelfth edition. Pp. xxx+1045. (London: H. K. Lewis, 1906.) Price 10s. net.

THIS most useful volume has now reached its twelfth edition, and extends to more than a thousand pages. The pages are small ones, but packed with information, and the paper is thin, so the volume still remains one of handy size. The book is more than its name indicates; it not only includes remedial agents which have been introduced up till now into medical practice, but contains a great deal of information regarding recent research in disease. For instance, we find an excellent summary of the present state of the cancer question, the newest methods of bacteriological investigation, and a concise statement of modern views on toxins and antitoxins, serum therapy, opsonins, and the like. No busy practitioner can afford to do without such a convenient and trustworthy *vade mecum*.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Extirpation of the Tsetse-fly: a Correction and a Suggestion.

IN my letter published in NATURE of October 25 on the breeding haunts of the tsetse-fly discovered by Dr. Bagshawe, I stated that there were no banana plantations on the deserted island of Kimmi, on the Victoria Nyanza, and suggested that the flies there must have some other breeding-places than the plantations. I am informed, however, by my friend and colleague Lieut. A. C. H. Gray, R.A.M.C., who has just started for Uganda, that he and the late Lieut. F. M. G. Tulloch, when collecting flies on Kimmi, came across deserted banana plantations, overgrown by the forest and bearing ripe bananas (a sure sign that no natives visit them or know of them). I must correct, therefore, my former statement.

If the banana plantations should prove to be the sole or principal breeding-place of the tsetse-fly, the question at once arises, what means could be taken to exterminate the fly or check its increase? To destroy the plantations would be impossible, as I have said, because the banana is the staple food of the country. I venture to suggest that an efficient means of keeping down the tsetse-fly would be to encourage or constrain the natives to keep fowls in their plantations in places where the fly is abundant. These birds would scratch up and discover the pupæ much quicker than a man could, and would probably devour them greedily when found. In forest districts it might be seriously considered whether it would not be advisable to introduce the Indian jungle-fowl for the same purpose. It is, of course, always a risky thing to introduce exotic wild species into a country, but the jungle-fowl, being a valuable game-bird, could hardly be a serious nuisance, however much it multiplied.

I would suggest, further, that a most suitable place in which to try experiments on the extirpation of the fly would be the island of Kimmi already mentioned. Within easy reach of Entebbe, uninhabited, covered with forest or jungle, and swarming with tsetse-flies, it is a locality in which it would be very easy to introduce the jungle-fowl and to watch the effects. As there are no monkeys, so far as I am aware, on the island, the fowl would probably be able to flourish and multiply unchecked. Such an experiment, even if it failed to produce the desired effect, could do no harm, and if it succeeded would be of very great importance. E. A. MINCHIN.

Lister Institute of Preventive Medicine, November 2.

The Efficiency of the Present Process of Natural Indigo Manufacture.

IN NATURE of September 20 (vol. lxxiv., p. 526) I find mention of a paper read before Section B at the recent meeting of the British Association by Mr. W. Popplewell Bloxam on a new method of determining indigotin. It is stated that "the author concludes that the present process of manufacture is a wasteful one, the highest efficiency attained not reaching 50 per cent., whilst on the average only 25 per cent. of the indigotin in the leaves is extracted."

In justice to the indigo-planting community in India I think this statement should not go unchallenged. The grounds on which Mr. Bloxam draws his conclusion are not given in the brief *résumé* of his paper in NATURE, and I am therefore obliged to seek an explanation in his communication to the Journal of the Society of Chemical Industry of August 15 on the same subject, in which a similar statement of the low efficiency of the indigo-manufacturing process is made. In this paper Mr. Bloxam gives the analysis obtained by his new method of the indigo turned out each day during the manufacturing season at a certain factory in Bihar. From the figure so obtained and the total daily outturn of finished indigo recorded in the factory "mahai" book, he calculates the amount of indigotin produced day by day, and from the proportion existing between the amount so calculated and the amount theoretically obtainable, deduced from the weight of green plant placed in the vat and *the assumption that this plant contains 0.6 per cent. of indigotin*, he arrives at his estimate of the efficiency of the manufacturing process.

Now it is clear that in this method of calculation error may occur in the following particulars:—

(1) The analysis of the finished indigo.
(2) The weighment of the daily outturn of finished product.
(3) The weighment of the green plant.
(4) The assumed content of indigotin in the green plant.

The first point is one for discussion elsewhere. It is sufficient for my present purpose to point out that the average of Mr. Bloxam's results (60 per cent. indigotin) agrees substantially with the average quality usually accepted as typical of Bihar indigos, and that, therefore, his results probably do not differ very widely from the truth. The same cannot be said of the second point. Separate weighment is hardly ever made of the daily outturn of an indigo factory, and I know as a fact that this was not done in the case on which Mr. Bloxam bases his figures. A rough estimate of the outturn is arrived at by measurement of the cakes produced in a wet condition, and the result obtained generally falls short of the actual production by 10 per cent. to 30 per cent. Mr. Bloxam must therefore have obtained his figures from cake measurement—at best a very inaccurate proceeding.

Similar inaccuracies occur in the weighment of the green plant in the ordinary factory routine, but the culminating error on which Mr. Bloxam's figures are based occurs in his assumption of 0.6 per cent. as the amount of indigotin occurring in the green plant. It has been my privilege to serve the indigo planters in Bihar in a scientific capacity for nearly five years. During this time I have carried out some hundreds of analyses of indigo plants of all varieties, ages, and sizes, and in only one or two cases has so high an indigotin content as Mr. Bloxam assumes is normal been recorded. These were in cases of the Java plant (*Ind. arrecta*, which contains an exceptional amount of indigotin, and was only being cultivated on a small scale during the season from which Mr. Bloxam's conclusions are drawn) under peculiar conditions of manuring. It would be more accurate to place the average indigotin content of the plant used during the season quoted by Mr. Bloxam at 0.3 per cent., so that his estimate of the efficiency of the manufacturing process should be doubled.

As a matter of fact, recent work, carried out with attention to the details I have enumerated, has shown that the process may with care, but with no modification other than is available to every planter, be rendered as efficient as 70 per cent. to 80 per cent., and that as it is carried out by the average planter it seldom falls below 60 per cent. C. BERGTHEIL.

The Research Station, Sirsiah, Mozufferpore, India, October 10.

The Leonid Meteors.

THOUGH the Leonid epoch of 1905 does not seem to have been marked by a great abundance of shooting stars, a magnificent aurora having unexpectedly taken the place on the evening of November 15 of the shower anticipated later on that night, yet it is probable that in the absence of moonlight and cloud the radiant in Leo would have been found to be more active than seemed to be the case. The phase of the moon renders the conditions for good observations more favourable in the present year, and it is probable that if the weather during the critical period turns out fine, Leonids will be observed in considerable numbers. In 1906 these meteors become due on the night of November 15. The anticipated display is connected by the nineteen-year period with the shower of November 14, 1868, and, like the latter, will be visible over both Europe and America. As calculated by the writer, the principal maxima take place on November 15 at 12h. 45m., 14h., 19h., and 21h. 40m., G.M.T. These maxima will therefore occur on the morning of November 16, the first two being visible here, while the remaining two, which repre-

sent by far the stronger portion of the shower, will fall to the lot of American observers

The calculated intensity of the shower is rather inferior to that of its prototype of 1868, besides, the first maxima fall early in the night, and may not, therefore, be seen at their best Nevertheless, the present epoch is a well-defined one, and should yield satisfactory returns to the vigilance of meteor observers.

Of the minor showers associated with the period, the most interesting occur on November 16 between 13h and 14h, and on November 17 from 13h to 18h

Dublin JOHN R HENRY

The Rusting of Iron

IN reference to the discussion on the rusting of iron in recent numbers of NATURE, I happen to have a curious specimen illustrating the accumulating of rust which may possibly be of some little scientific value It is a horse-shoe which was dug up some years ago by a child out of the sand on the site of the battle of Prestonpans, near Edinburgh It was given me by the child's father, who was with him at the time The shoe is now very irregular and lumpy The thickness of the naked iron can be made out at one spot, where it is partially denuded It is just three-eighths of an inch But with the mass of what I can only describe as rust, and I presume sand—some small pebbles are, too, imbedded in it—it is in one spot as thick as 2 inches, and in girth it there measures 6⅝ inches No part of it is wholly clear of rust, the smallest girth is 4 inches

The famous battle was fought on September 21, 1745, and the supposition is that the shoe if not the horse was lost there The supposition is probable enough If correct the rust would represent the accumulation in a century and a half I may add that I have some specimens of pig-iron which were turned out at foundries here fifty years ago, and have been in the open air ever since They have just a brown coat, but the coat is of no perceptible thickness

JOSEPH MEEHAN

Creevelea Drumkeeran, October 29

PROTOZOA AND STATOZOA[1]

THE late publication of the first volume of this well-known series has enabled the authors to incorporate some of the results of the more recent researches upon their several subjects Taken in conjunction with the earlier published volumes, the work seems to fulfil the purpose of providing an intelligible and adequate survey of the entire animal kingdom without giving undue prominence to particular groups

Prof Hartog's share in the work makes a well-timed appearance in the year which has witnessed something like a crisis in the history of protozoology His chapters are full of suggestive comparisons and analogies, and their value is increased by the addition of copious footnotes Some of the statements are not supported by references as, for example, where he speaks of the presence of a contractile vacuole in the zoospores of algæ and fungi without mentioning any specific instances of this condition (p 15)

The essential complexity of the simplest manifestations of living matter is made evident, and Prof Hartog does not harmonise the vitality of protoplasm with the vagaries of a drop of oil or of a bubble The segmentation of the oosperm of Metazoa and Metaphyta is compared with the sporulation of the Protista, both phenomena being characterised as brood-formations (p 31)

In the second chapter the author begins with an interesting disquisition on the old belief in spontaneous generation as an explanation of the origin of the organisms of putrefaction, pointing out how this was due in part to the supposed inconstancy of species in Protista, and that this in turn resulted from the want of knowledge of their life-histories, how this knowledge was supplied in the first place by the Rev W H Dallinger and Dr Charles Drysdale for Protozoa, and for the Protophyta by F Cohn and later by von Koch, who perfected the methods of culture devised by De Bary for the study of the fungi

In his remarks on reproduction by syngamy Prof Hartog distinguishes between exogamy and endogamy, the rhizopod Trichosphærium affording an example of the exogamous conjugation of biflagellate isogametes while the heliozoan Actinosphærium practises endogamy

Referring to the pelagic foraminifer Globigerina (p 61), the author says that after death the tests sink to the bottom of the sea to form the "Globerina ooze" (sic), "at depths where the carbonic acid under pressure is not adequate to dissolve the more solid calcareous matter" On the following page we read —"Some Foraminifera live on the sea bottom,

FIG 1—*Cerianthus membranaceus* in its tube Colour pink, with tentacles annulated pink and brown About 35 cm in length From The Cambridge Natural History, vol 1

even at the greatest depths and of course their shell is not composed of calcareous matter" There is nothing to indicate to the reader why this is more obvious than any of the other plain statements in the book

The first three chapters of Dr Hartog's treatise deal with the Sporozoa the Flagellata, the Ciliata and the Suctoria As an illustration of the rapid strides of recent years he notes that seven years ago no single species of Sporozoa was known in its complete life-cycle It would have been better to have used the general expression "body-cavity" instead of "cœlom" on p 105 Cœlom and hæmocœl are both body-cavities, just as clothes props and thoroughbreds are both horses!

The importance of investigations into the life-

[1] "The Cambridge Natural History" Vol 1 Protozoa by Prof Marcus Hartog, Porifera (Sponges), by Igerna B J Sollas, Cœlenterata and Ctenophora, by Prof S J Hickson, F R S Echinodermata by Prof E. W MacBride, F R S Pp xvii+671, illustrated (London Macmillan and Co., Ltd, 1906.) Price 17s net

histories and microchemical properties of the Protozoa which may be said to have achieved their present culmination in the life and death of Schaudinn, is worthily presented by Dr Hartog

Miss Sollas's three chapters commence with a brief historical introduction followed by a lucid description of two typical British sponges *Halichondria panicea* and *Ephydatia fluviatilis* The traces of a nervous system referred to on p 39 of this volume are not to be found here Chapter viii concludes with a key to British genera of sponges, comprising seventy-one names, and chapter ix deals with questions of reproduction, physiology, and the formation of flints

Turning now to Prof Hickson's valuable contribution, we note that he treats the Cœlenterata and the Ctenophora as separate phyla instead of regarding the former as divisible into two branches the Cnidaria, those which are armed with stinging threads, and the Ctenophora, those which are provided with swimming plates A more serious change which he has introduced is the resolution of the old order Hydrocorallina into two distinct orders, Milleporina and Stylasterina the former second the latter sixth, in the list of orders, separated in the text by the Gymnoblastea, the Calyptoblastea, and even the Graptolitoidea

With regard to the relations between the hydroid stock or hydrosome and the medusoid gonophore or medusome of the Hydrozoa, Prof Hickson gives expression to the perennial "vexed question" as to whether the hydrosome preceded the medusome or *vice versâ*, he does not assist the reader by adducing analogous instances The stock and sexual stolon of some annelid worms would seem to offer an almost exact analogy to the hydroid and medusoid phases of a hydrozoan, the medusome might even be regarded as an epitokous sexual phase, the stock being the parent form, indifferently whether it is fixed or free, the liberation of the medusæ (where this occurs) would correspond broadly with the swarming of the epitokes

The general treatment of the three classes Hydrozoa, Scyphozoa, and Anthozoa, leaves little to be desired within the limits prescribed by the nature of the work, and prominence is given to bionomical questions

Prof Hickson's last chapter is concerned with those wonderful creatures of the plankton, the Ctenophora In describing the planes of symmetry of the body, the author speaks of the tentacular or "transverse" plane and of the "sagittal" plane These animals show no antero-posterior differentiation, and only in one order, the Platyctenea, do they exhibit dorso-ventral differentiation, their symmetry is biradial, and it is undeniably inaccurate to saddle them with transverse and sagittal planes If a comparison with higher forms must be made, there are strong reasons for the belief that the tentacular plane of the Ctenophora should be likened to the sagittal plane of Bilateralia

In his account of the siphonophoran body (p 298) Prof Hickson evinces a general willingness to steer clear of wearisome polemical discussions, in this case the difficulty might have been surmounted by calling the various parts of the colony neither organs nor zooids, but organozooids

The volume concludes with six chapters on the Echinoderms from the pen of Prof MacBride In the classification of the Ophiuroidea the author has followed Prof Jeffrey Bell's system which seems to have achieved the distinction of permanency The tabulation of the families of Asteroidea is based upon Prof Perrier's system and gives a very different sequence from that based upon Mr Sladen's orders also in vogue at the present time In the chapter on the Echinoidea (sea urchins) there are interesting passages on the physiology of the pedicellariæ, the chapter on the Holothuroidea (sea cucumbers) contains a humorous though instructive comparison between the organisation of a Synaptid and that of a Sipunculid

The final chapter is devoted to questions of development and phylogeny It seems probable to Prof MacBride, and will doubtless appear so to his readers, "that Vertebrata and Echinodermata both arose from Protocœlomata" It remains to be added that the illustrations are excellent, and many of them original

The term "Statozoa," originally applied to certain Echinodermata, but not generally adopted in that connection, may be conveniently extended so as to include such animals as sponges, cœlenterates, and echinoderms, in which a fixed condition is either actually or phyletically predominant

FIG 2 —*Cucumaria crocea* carrying its young ×1 From "The Cambridge Natural History," vol i

THE INTERNATIONAL GEODETIC CONFERENCE AT BUDA PEST

THE International Geodetic Association held its triennial conference at Buda Pest from September 20 to 28, and I had the honour of serving as the delegate of our Government. By the kindness of the Hungarian Academy the meetings were held in their handsome building, and the arrangements for our reception, which had been made by M. Louis de Bodola, were in every way admirable. Before considering the scientific work of the conference I may mention that the Prime Minister, Dr. Wekerle, invited the members of the "Permanent Commission" to dinner, and that the Archduke Joseph afterwards received all the delegates at the palace. On subsequent days the Burgomeister of Buda Pest gave a dinner in our honour, as also did Count Albert Apponyi, Minister of Public Instruction.

The work of the conference was more interesting than that of any other at which I have been present, and the time was barely sufficient for the adequate discussion of many subjects of importance. In an article of this character it will clearly be impossible to do more than indicate in general terms the subjects which were considered.

The systematic observation of the variation of latitude, which is the special province of Dr. Albrecht, was naturally the subject of much discussion. The existence of a mysterious term in the expression for the position of the pole was discovered some years ago by Prof. Kimura. If this term, which is denoted by the letter z, has a real physical existence it would indicate that the equator oscillates backwards and forwards, moving parallel to itself. It appeared that observations conducted in the southern hemisphere would quickly determine the reality of the supposed motion. Accordingly, at the conference of Copenhagen in 1903 it was resolved that observations in the southern hemisphere should be instituted, and should be carried out for a period of at least two years. The southern observations of latitude are to be made at Bayswater, West Australia, where Dr. Hessen began his observations on June 6, 1906, and at Oncativo, in the Argentine Republic, where Prof. Carnera began work on May 5. These two stations are in S. latitude 31° 55′. We also heard from Mr. Innes that latitude observations will probably be commenced at Johannesburg (S. latitude 26° 12′) by the end of the present year. With regard to the observations in the northern hemisphere, it was resolved that they should be continued, at least until the year 1909, when the next conference will meet. The northern stations are Pulkova and Leyden, and in N. latitude 39° 8′ Mizusawa, Charjui, Carloforte, Gaithersburg, Cincinnati,[1] and Ukiah, together with Tokyo in latitude 35° 39′. Prof. Helmert gave an interesting account of the present condition of the whole investigation, and he directed attention to certain oscillations or systematic errors of which the physical meaning is as yet altogether obscure. Whatever their meaning may be, their magnitudes are excessively minute.

Another report of importance was one by Dr. Albrecht on the use of wireless telegraphy for the determination of differences of longitude. He concludes that this method may be relied upon to give as good results as those derived from telegraphy through wires.

Dr. Hecker had undertaken, at the expense of the association, a second long sea voyage for the purpose of determining the value of gravity at sea. His first voyage was from Portugal to Brazil, and the second was in the Indian Ocean and across the Pacific. He presented a short preliminary report in which he stated that the intensity of gravity for the deeper part of the Pacific Ocean is approximately normal and agrees closely with Helmert's formula of the year 1901. His experience in the first voyage had enabled him to effect considerable improvements in the procedure. The method depends upon the determination of the temperature of boiling water and the simultaneous observation of the height of the barometer. The difficulties in attaining at sea to the requisite degree of accuracy are so numerous that it is matter of surprise that trustworthy results can be obtained. There seems, however, to be now no doubt that we may trust his conclusions. Dr. Hecker exhibited his apparatus with five barometers furnished with the means for obtaining continuous photographic records of the height. One of the greatest difficulties to be contended with is the motion of the ship, for the pitching and rolling make the mercury in the barometer "pump," and the photographic trace of the barometer height is marked with regular notches. Dr. Hecker is to be congratulated on the skill with which he has overcome this and many other difficulties. His conclusions form one of the most noteworthy acquisitions to geodetic knowledge of the last twenty years.

MM. Claude and Driencourt gave an account of the use of their prismatic astrolabe. It gave me the impression that it might be an instrument of much use to geodesists.

The measurement of base lines naturally afforded an important subject of discussion, and M. Guillaume, assistant director of the International Bureau of Weights and Measures at Breteuil, gave an admirable account of the recent improvements which have been effected in the use of the Jaderin wires. It would appear that the measurement of base lines has now reached such perfection that we cannot look for any great advance in geodetic accuracy in this direction. Errors due to triangulation accumulate rapidly, and the modern practice is to measure short bases about every 200 miles. The Simplon Tunnel has been used by the Swiss geodesists as a base line, and was measured by the Jaderin apparatus. The railway company was good enough to surrender the tunnel to the geodesists for five clear days, and by means of continuous work day and night they were able to complete their task. A special form of tripod for supporting the wires was devised; it rolled along the railway lines, and in this way the labour of transporting the tripods was considerably diminished.

The national reports furnished by the several delegates were in many cases of great interest, but I can only refer to a few of them.

The work of the Swiss in the measurement of a base along the Simplon Tunnel has already been mentioned.

A proposal has been made for the collaboration of the French and Italians whereby the island of Sardinia may be linked to Corsica and to the Italian mainland.

The French delegates gave a final account of the measurement of the great arc of Peru. This work took five years, and eleven officers of the Service Géographique de l'Armée and twenty-eight under officers and soldiers took part in it. Several of the staff died of exposure and hard work in the Cordillera, and the conference received this intimation standing in token of respect to their French comrades who lost their lives in the cause of science.

I myself presented reports from Colonel Burrard, R.E., on the work in India, and from Sir David Gill, Colonel Morris, and Mr. Simms, on the geo-

[1] The observations at Cincinnati will, as I understand, be discontinued shortly.

detic survey in South Africa. The conference listened with interest to the account of the various difficulties which had been met with in Africa.

It is well known that the British South African Company, in fulfilment of the wishes of the late Mr. Cecil Rhodes, has up to the present year met all the heavy expense of that part of the survey along the thirtieth meridian of east longitude which runs through Rhodesia, but it has been found necessary for the company to effect various economies, and there was a doubt as to whether it might not prove necessary to suspend the survey for a time. Such a suspension would have proved most unfortunate, since there would have been no junction to the southward between the Rhodesian triangulation then completed as far as Gwelo and the Transvaal triangulation which begins at the Limpopo River. A surveying party under Captain Gordon, R.E., was already in the field in Rhodesia, and it was obvious that it would be much more economical to continue the work at once rather than to defer it until some undetermined time in the future. The expenditure needed for the survey from Gwelo to the Limpopo was estimated at 1600*l*. and after various negotiations in England the British South African Company offered to advance half that sum, while the Royal Society, the British Association (from a fund raised principally in South Africa for the meeting of 1905 at Cape Town and Johannesburg), the Royal Geographical Society, and Sir Julius Wernher subscribed the other half. These negotiations had to be conducted very hurriedly in order to obviate the break-up of the surveying party, but by means of the telegraph and through the exertions of Sir David Gill all obstacles were overcome, and Captain Gordon began work in June. Since the meeting of the geodetic conference I have heard from Sir David Gill that Captain Gordon is making good progress. Thus in a few months the triangulation will be finished up to and beyond the Zambezi. With respect to Northern Rhodesia, preliminary reconnaissance has been made nearly as far as Lake Tanganyika, and I have reason to hope that, although Sir David Gill is retiring from his position as Astronomer Royal at the Cape of Good Hope, the British South African Company will make arrangements for the completion of the great scientific enterprise for which they have already done so much.

At Lake Tanganyika the continuation of the survey northward will fall to the Imperial German Government. The Academy of Sciences of Berlin has appointed a committee to consider the matter, and although Dr. Helmert was not able to announce that the work would be undertaken immediately, yet I think we may be confident that the northward progress of the survey will be continued in a year or two.

In Egypt Captain Lyons is making preparations for the geodetic survey southward, and I have no doubt that when the conference next meets substantial progress will be reported there also.

In the years 1903 and 1904 the International Congresses of Geology and of Academies passed resolutions in which they asked for the help of the Geodetic Association in respect to accurate levelling and measurements of gravity with a view of throwing light on the internal distribution of masses in the earth and on the rigidity and isostasy of the crust of the earth. It was entrusted to M. Lallemand and to me to draw up preliminary reports on these subjects. M. Lallemand, whilst admitting the importance of the requirements of the geologists, could not maintain that levelling has attained to such a high degree of accuracy as to betray small movements of the land relatively to the sea, but he thought that large changes of level could be detected, and he expressed the opinion that the lines of levelling ought to be repeated at such intervals as two or three times a century. For my part I could not think that it was possible for geodesists to undertake such elaborate measurements of the direction and intensity of gravity as would fully satisfy the requirements of geologists. The repetition of the levelling of a country and systematic observations of gravity entail great expense, and the conference seemed to be unanimously of opinion that they would not be justified at present in urging on their respective Governments any increase of expenditure in these directions. Nevertheless, the wishes of the geologists will not pass unnoticed, for there can be no doubt that in future campaigns with the level and the pendulum more attention will be paid than heretofore to the constitution of the country under survey.

Before referring to the resolution on this topic which was finally adopted by the conference, I must speak of two other communications of great importance. Mr. Tittmann, superintendent of the United States Coast Survey, and Mr. Hayford, inspector of geodetic work, communicated on behalf of the United States a very elaborate discussion of the anomalies of gravity throughout the United States. The conclusions at which they arrived are of great interest to geologists, for it was shown by Mr. Hayford that, at least in the United States, the matter constituting the earth is in hydrostatic equilibrium at a depth of about seventy miles below the surface. In technical language this is the depth of isostatic compensation. In this connection Baron Eötvös, professor in the University of Buda Pest, explained his application of the torsion balance or Cavendish apparatus for determining local deviations from normality, both in the direction and in the intensity of gravity. His instrument, which we had the pleasure of seeing at the laboratories of the University, is of astonishing sensitiveness, and, so far as we can see at present, its indications are trustworthy. It would seem probable that this instrument might be used to give exactly those indications as to the distribution of internal masses of which the geologists are so desirous. The communication of Baron Eötvös was considered of so much importance that the conference directed special attention to it in the resolution which was adopted as an answer to the International Association of Academies. The Geodetic Association has at present no funds available for continuing researches with the torsion balance, but there is reason to believe that the Hungarian Government will continue to support Baron Eötvös in his researches. It may even become possible by measurements, say on Vesuvius, before and after an eruption, to find where the lava which is ejected from the crater has come from, since the displacement of large masses from beneath the mountain should be betrayed by the indications of the torsion balance.

This meeting of the conference is the last under the existing convention, which expires at the end of the present year, but it was announced that twenty of the Governments which have taken part in the existing convention have already entered into a new one for the forthcoming ten years. There is reason to believe that the Argentine Republic will also join. Indeed, Dr. Porro was at Buda Pest as representative of that Republic, and took part in our discussions.

A telegram has already appeared in the *Times*, and has been repeated in NATURE, stating that I have invited the conference to meet in Cambridge in the year 1909. This is incorrect. It is true that the association has never yet met in England, and I

believe that a meeting here would be of great value for British geodesy, but I told the conference that I had no power to give an invitation, which must come from the Government I can only now repeat the expression of the hope that the conference may meet in this country in 1909. G H DARWIN

THE FIRST "MANNED" FLYING MACHINE

OCTOBER 23 of the present year will be remembered as a red-letter day in the history of flying machines, for it was on that day that the first flying machine, constructed on the "heavier than air" principle, successfully raised itself *and its driver* from the ground several feet, and transported itself by means of its own power over a distance of eighty yards

In this his first successful flight with this machine, M Santos Dumont is to be sincerely congratulated for he has accomplished a performance which many workers in different parts of the world have been striving after for many years past and failed M Santos Dumont's machine is built on the aeroplane principle, and mounted on two wheels It is fitted with an eight-cylinder, 60 h p motor weighing about 170 lb, and drives an aluminium fan, which makes 1000 to 1500 revolutions a minute The motor is the work of the Adams Manufacturing Company, England With its driver the machine weighs about 750 lb

The aeroplane is shaped like a large T placed horizontally The short arms of the T are slightly inclined upwards, and are each composed of three compartments, like three box-kites tied together side by side At the base of the T is a large compartment, also like a box kite, and by manipulating this about a horizontal axis the upper and lower surfaces act as a powerful rudder This rudder arrangement is at the front end of the aeroplane and the operator stands on a platform midway between, and nearly on a level with, the lower surfaces of the two main inclined arms The driving fan is situated at the rear of the machine, just behind the operator, at the junction of the two main inclined arms

Now that success has rewarded this daring investigator, it is of interest to take a cursory glance at the steps which ultimately led the way to success

One naturally in the first instance, calls to mind the very interesting experiments carried out in 1893 by Herr Otto Lilienthal near Berlin (NATURE, vol xlix, p 157), because Santos Dumont's aeroplane is, generally speaking, somewhat after the style of the gliding machines used by him Lilienthal's experiments were confined to trying to learn soaring, and he employed slightly curved wings having a surface of about 15 square metres With these inclined planes, and eventually vertical and horizontal rudders, he started from the top of a hill, and after a few steps forward jumped into the air and glided sometimes 250 metres Lilienthal depended for the success of his apparatus on himself trusting to his instinct to be able to keep his balance by making the necessary compensating adjustments by moving his own centre of gravity In later experiments he employed some mechanical aid to assist him in sustaining himself longer in the air This consisted of a small machine driven by compressed carbonic acid gas, and operating a series of feather-like sails which were capable of flapping He found that occasional flapping of these wings helped him to cover longer distances

In 1895 he adopted a new principle, and instead of using one large framework, employed two smaller ones, placed parallel one above the other, this method he found distinctly advantageous (NATURE, vol liii, p 300)

About this time Lilienthal's soaring experiments began to be taken up both in this country and in America Mr Percy S Pilcher in England gained considerable experience both in the making and in the handling of these aeroplanes (NATURE, vol lvi, p 344) Unfortunately, as in the case of Herr Lilienthal, an accident during his experiments resulted in his death Pilcher, however was quite aware of the importance of using some motive power, and some time before his death proposed to employ, and actually began to make, a small and light engine, indicating about 4 h p, to drive a fan, this being considered by him as more than sufficient for flights of moderate length With this advance it was hoped that much greater distances could be covered, and a nearer approximation to a flying machine attained

There is little doubt that if Pilcher had been spared he would soon have constructed and made use of the latest and lightest form of motor, and probably been led to use the double-decked form of aeroplane adopted by Santos Dumont

By embodying the best ideas of his predecessors and using his own ingenuity to make the aeroplane a practical flying machine, Santos Dumont has advanced the science of aeronautics a very considerable step The petrol motor has no doubt helped greatly in facilitating this progress, since high-powered engines of comparatively very light weight can be constructed

In this pioneer work of navigating the air the work of Hiram Maxim and S P Langley must not be forgotten Maxim made numerous attempts to drive his flying machine at such a speed that it would be lifted off the rails on which it ran but on no occasion could it be said that this was successfully accomplished Further, it was not known whether it would capsize or not if it was set free Langley, on the other hand was undoubtedly the first to demonstrate that a machine heavier than air could be made to travel in the air driven by its own power The machines he made and launched were all "unmanned," but nevertheless much valuable information was accumulated

This the latest achievement of Santos Dumont will no doubt give a fresh impetus to the problem of flight and those who have the money and time have now before them a successful aeroplane that can serve as a starting point

THE UNIVERSITY MOVEMENT IN WESTERN AUSTRALIA

A MEETING in support of the movement for founding a university in Western Australia was held on September 7 at Perth, Western Australia The chair was taken by Dr J W Hackett, and the principal speakers included the chairman the Right Rev Dr Riley Anglican Bishop of Perth, Dr Hill master of Downing College Cambridge who is at present lecturing in Western Australia and the Speaker of the Legislative Assembly Mr Quinlan In 1904, during the Premiership of Mr Walter James, 4000 acres of land in the vicinity of Perth were set apart by the Legislative Assembly as a permanent endowment for the University of Western Australia when it should come to be formed The present income from this endowment is practically nil but its future value is likely to be considerable

Dr Hackett in his remarks explained the general

view that the university should be to enable the youth of the country to develop their faculties to their full capacity, and to permit them to compete on even terms in the practical business of life with those outside as well as inside Australia. Dr Hill, in a valuable contribution to the discussion, advocated the utilisation of existing institutions, the training college for teachers, the magnificent observatory, the museum, zoological gardens, law courts, and hospital, for the teaching purposes of the university, and suggested that many of the gentlemen holding Government appointments—the geologist, electrician, bacteriologist, &c., were eminently fitted to occupy university chairs in addition to their official duties. They did not require a palace for a start, but the men. In these days of change a great stone building was a disadvantage. His idea was to forget finance, and to coordinate the existing material. Ultimately a resolution in favour of the establishment of a university was carried with practical unanimity.

At present the higher education of Western Australia is in the hands of the University of Adelaide, which conducts the examinations and gives courses of extension lectures, and this system has worked well in the past, but naturally is only provisional. In addition, the Gilchrist trustees, through Dr R. D. Roberts, of the London University Extension Board, have for the past three years contributed to the expense of sending an annual lecturer from this country to give a course of lectures in some branch of science. These lectures are eagerly attended, and now form quite a feature in the intellectual life of the State, periodically stimulating the movement in favour of an independent university. Audiences of from 1000 to 1500 are sometimes drawn. It is difficult to say whether the lecturer or his audience derive the greater benefit. Certainly a trip round the world with a course of lectures taking one over a large part of a new continent, among the goldfields of Kalgurli, the jarrah and karri forests of the south-west, the orchards and vineyards of Armadale, is an experience fitted to make a lecturer return to his homely desk with "renewed vinegar."

The present writer recalls many a strange impression from his lecturing experience in Western Australia, a wine neither a hock, a claret, nor a madeira, something of each, but better than all; a third-class sleeping carriage on a narrow-gauge single-line railway, not yet to be found on our boasted Scotch expresses; gold in sight in the wall-face of one working not yet worked, estimated of the value of half a million sterling; a water scheme for supplying the mines, pumping a million and a half gallons daily over a watershed of 1500 feet a distance of 300 miles, in which the water spends six weeks in the pipes before reaching its destination; a camel, the only need of which in the desert is a weekly drink of water costing, maybe, 30s.; a criticism of the last night's lecture scribbled in pencil at the bottom of one mine and delivered to the lecturer in the next without coming nearer the surface than 1200 feet; a rabbit which survived two summers of drought without water; and a clergyman who took for his text "Radium."

In wishing the university movement well in Western Australia one may express the hope that it will still continue its policy of inviting outside lecturers to come and learn as well as to teach, and that many professors without portfolios may be induced to visit its shores in the future, to carry back with them an idea of a developing outside world which in the cloistered seclusion of a university is in danger of slipping from the memory.

F. S.

NOTES

THE following is a list of fellows who have been recommended by the president and council of the Royal Society for election into the council for the ensuing year:—*president*, Lord Rayleigh; *treasurer*, Mr A. B. Kempe; *secretaries*, Prof. J. Larmor, Sir Archibald Geikie; *foreign secretary*, Mr Francis Darwin; *other members of the council* (the fellows whose names are printed in italics are not members of the existing council), *Lord Avebury*, *Sir Benjamin Baker, K.C.B.*, *Dr H. F. Baker*, Prof. J. Norman Collie, Prof. Wyndham R. Dunstan, *Prof. David Ferrier*, *Prof. Sydney J. Hickson*, Sir William Huggins, K.C.B., Prof. E. Ray Lankester, Mr H. F. Newall, *Dr Alexander Scott*, *Prof. A. C. Seward*, *Prof. W. J. Sollas*, Prof. E. H. Starling, *Prof. Silvanus P. Thompson*, and *Dr A. D. Waller*.

THE Royal Society's medals have this year been adjudicated by the president and council as follows:—the Copley medal to Prof. Elias Metchnikoff, for the importance of his work in zoology and in pathology; the Rumford medal to Prof. Hugh Longbourne Callendar, for his experimental work on heat; a Royal medal to Prof. Alfred George Greenhill, for his contributions to mathematics, especially the elliptic functions and their applications; a Royal medal to Dr Dukinfield Henry Scott, for his investigations and discoveries in connection with the structure and relationships of fossil plants; the Davy medal to Prof. Rudolf Fittig, for his investigations in chemistry, and especially for his work in lactones and acids; the Darwin medal to Prof. Hugh de Vries, on the ground of the significance and extent of his experimental investigations in heredity and variation; the Hughes medal to Mrs. W. E. Ayrton, for her experimental investigations on the electric arc, and also upon sand ripples. The King has approved of the award of the Royal medals. The medals will, as usual, be presented at the anniversary meeting on St. Andrew's Day (November 30). The society will dine together at the Whitehall Rooms on the evening of the same day.

Two events during the past few days have shown that men of science recognise the ability of women to originate and carry out scientific research and inspire others with their spirit. One is that on Thursday last the Royal Society awarded the Hughes medal to Mrs. W. E. Ayrton for her experimental investigations on the electric arc and also upon sand ripples, and the other event is the first lecture delivered at the Sorbonne on Monday by Mme. Curie, who has succeeded the late Prof. Curie in the chair of general physics of the University of Paris. Both Mrs. Ayrton and Mme. Curie originated and carried out their scientific investigations unaided, and the tacit acknowledgment just made of their creative capacity—essential to work of this kind—is interesting and significant. Though some of Mrs. Ayrton's experiments on the electric arc were made in the laboratories under Prof. Ayrton's charge at the Central Technical College, it was to her alone that the conception and carrying out of the experiments were due, as well as the original speculations deduced from the results. The Royal Society, by placing Mrs. Ayrton's name alone, and not bracketed with that of a man, in the list of medallists for this year has manifested its recognition of individual work by a woman. The Davy medal was awarded by the society in 1903 to Prof. Curie and Mme. Curie jointly, for their researches on radium, though the published work on the subject shows that the discovery of radium was due to Mme.

Curie alone. But however this may be, it should be gratifying to those who have worked for the extension of opportunities for intellectual work by women to find that the scientific world is prepared to acknowledge merit without distinction of sex. The logical result of the action of the Royal Society and the University of Paris is that women should be eligible for election into any society or academy that exists for the purpose of extending the boundaries of natural knowledge.

A MEETING of the executive committee of the British Science Guild was held at the rooms of the Royal Society on November 2, Mr. Haldane, M.P., president of the Guild, in the chair. In addition to the ordinary business the following matters were under consideration:—a memorandum on the application of improved methods in agriculture, an interim report of a subcommittee of the Guild on the amendment of the British patent laws, the appointment of local committees of the Guild in industrial centres, and the proposed anthropometrical survey.

DR. J. GUNNAR ANDERSON has been appointed director-general of the Geological Survey of Sweden in succession to Dr. A. E. Tornebohm, who retires.

THE Swiney lectures on geology in connection with the British Museum (Natural History) are being delivered this year by Dr. R. F. Scharff, who commenced on Monday a course of twelve lectures on the "Geological History of the European Fauna" in the lecture theatre of the Victoria and Albert Museum, South Kensington. The lectures will be given on Mondays, Wednesdays, and Fridays, at 6 p.m. Admission to the course is free.

DR. POIRIER, professor of anatomy at the Paris Academy of Medicine, has proposed the establishment of an organisation to combine the efforts of French investigators who are studying cancer. It is hoped that France will before long have an institute similar to that in connection with our Imperial Cancer Research Fund, and to corresponding institutions in Germany and the United States. Dr. Henri de Rothschild has contributed 4000*l.* to the funds of the proposed league against cancer.

THE preliminary forecast of the indigo crop of Bengal for 1906 is given in the *Pioneer Mail*. It appears that, owing to the competition of the synthetic dye, the area under indigo has contracted very rapidly. The cultivation is being gradually abandoned in Lower Bengal. The total area sown this year is 138,300 acres, against 170,700 acres of last year, and 223,100 acres of 1904. Of the important districts, Saran reports 62 per cent. of a normal outturn per acre, Darbhanga reports 57 per cent., and Muzaffarpur 33 per cent., while Champaran reports only 27 per cent. The estimated outturn per acre for Lower Bengal, including the minor Behar districts, is 67 per cent. of a normal crop, and that for North Behar, including Monghyr, only 42 per cent. The average for the province comes to 46 per cent., against 47 per cent. The director of agriculture, however, thinks the district officers' estimates are unduly pessimistic.

COMMANDER R. E. PEARY, who has been in the Arctic region since July, 1905, when he left New York on the steamer *Roosevelt* to make a further attempt to reach the North Pole, arrived in Battle Harbour, Labrador, on November 3, and dispatched a message announcing his return. From this it appears that the expedition wintered on the north coast of Grant Land, somewhat north of the *Alert's* winter quarters. In February the sledge party went north *viâ* Hecla and Columbia, but was delayed by open water between 84° and 85°. Beyond 85° a six days' gale disrupted the ice, destroyed the caches, cut off communication with the supporting bodies, and drifted the party due east. Journeying over ice, farthest north was reached in lat. 87° 6', while the ice was drifting steadily eastward. The north coast of Greenland was arrived at afterwards, and by travelling along the Greenland coast the ship was regained. A sledge journey was then made to the west, and the message states that the party "completed the north coast of Grant Land, and reached other land near the hundredth meridian." Further details about the movement of the ice and the land to the north of the hundredth meridian west of Greenwich, that is, north of the American mainland, will be awaited with interest. The most northerly point reached—lat. 87° 6'—is nearly three degrees farther north than Commander Peary attained in 1902. The Duke of the Abruzzi's expedition reached lat. 86° 33' 49", in long. 64° 30' E., in 1900.

THE promise of an interesting and useful addition to the local museums in the London district has been furnished by the spirited action of the Tottenham Local Board. In 1892 the Board purchased the fine "Queen Anne" mansion known as Bruce Castle from Mr. Joshua Pedley at the price he had given for it, 15,000*l.*, toward which sum he contributed 700*l.*, in the hope that some day the house would become the home of a museum for Tottenham. The estate included twenty acres of garden and timbered land, which was soon thrown open as a public park. The idea of a museum having been grasped, many specimens and offers of aid came in from neighbours and friends. By gift and as a result of a public subscription several important collections were acquired. Especially worthy of mention are the long series of birds, small mammals, and insects in cases and cabinets made by Mr. H. W. Roberts, formerly a resident in Tottenham, a collection of minerals and fossils formed by Mr. Penstone, a friend of John Ruskin, and the collections of fossils and wax models made and lent by Mr. H. J. H. Smedley. Mr. Smedley is acting as honorary curator, and has generously devoted much time and skill to getting the collections into a fit state for public exhibition. Other important gifts have been made by Mr. C. C. Knight, the Hon. Walter Rothschild, Mr. Ruck, Mr. Currie, and others. The museum was publicly opened by Mr. W. W. Lewin, chairman of the libraries committee, and Councillor Knight on October 26. Mr. Smedley is responsible for the scheme of the museum, which will embrace a purely local collection of Middlesex natural history and illustrations of ancient Tottenham, while the educational aspect will be kept well in view, including exhibitions of living animals and plants designed to encourage observation at first hand in the field amongst the young people and school pupils in the district.

IN commemoration of the forty years' reign of H.M. King Charles I. of Rumania, an exhibition is now being held at Bucharest, where the fifth Congress of the Rumanian Association of Science also assembled during last month, and was attended by more than four thousand members. Judging from the importance of the papers read and the discussions following, there is noticeable a decided advance in the appreciation of the value of education on the part of the Rumanians. The congress was divided into ten sections, the best attended being the one dealing with educational science, numbering more than three thousand members, including university professors and teachers of all classes. Great attention was given in this section to the question of extending the

number of hours at schools prescribed for physical training and military drill The economic science section was also well attended, and great interest was attached to the papers read dealing with the betterment of the status of the peasantry, a subject which engages the attention of all political parties of the country The outcome of this meeting has been the inauguration of a special society, starting with above two hundred members and having as its object the thorough investigation and discussion of the social and economic problems of Rumania One of the characteristic features of the congress was the fact that, for the first time, the clergy, as a body participated by forming a separate section, and among other questions discussed the scientific aspects of religious teaching It is believed that the industrial and commercial section will grow in importance in the near future Among the other sections in which good work was done, mention may be made of the medical, physical, and chemical sections On the whole more than 160 papers were read Much credit is due for the success of the congress to the president, secretaries, and council of the association who, through their energy and zeal, have secured a promising future for their association in the welfare of which the King and Queen of Rumania and the Royal Family take a great interest The next congress will be held in September 1907, at Focsani

CORALLINES and burrowing-sponges, illustrated by a plate reproduced from Johnston together with an account of the abnormally grown beak of a bird (presumably a rook, although no statement to that effect is made in the text) and sundry notes and observations on natural history, form the chief zoological contents of the *Museum Gazette* for October

THE issues of *Naturwissenschaftliche Rundschau* (published at Brunswick) for October 11 and 18 contain articles on "embryonic transplantation" (*embryonale Transplantation*) and the present state of our knowledge of the "rarer earths" Embryonic transplantation it will be remembered, was the name given by G Born of Frankfort-on-Maine to the operation of grafting portions of one young larva of a newt or frog on the body of another, whereby two-headed or double tailed monsters were produced In the opinion of the author Prof H Spemann of Wurzburg the continuation of such experiments would probably shed light on certain obscure biological problems In the course of his article on the rarer earths, Dr R J Meyer of Berlin points out that scandium, which was found in 1879 in gadolinite and euxenite, and appears never to have been seen again in that state, is the scarcest member of the whole group, if, indeed, it be rightly included therein

In the October issue of the *American Naturalist* Mr J C Herrick communicates an illustrated account of the results of his investigations into the mechanism of the dental, or "odontophoral," apparatus of the gastropod *Fulgur* or *Sycotypus canaliculatus* Especial attention was directed in this investigation to the discovery of the manner in which the gastropod perforates the shells of other molluscs The mechanism of the "radula," or dental apparatus corresponds, in the case of this genus at any rate, to the action of a chain-saw, with the restriction that the sawing action is accomplished only during the return stroke The buccal cartilage forms a stiff framework and a grooved passage for the radular sac and the retractor muscle of the dental ribband The muscles for protruding and retracting the radula are of very different power, owing to the fact that, from the backward direction of the teeth, the rasping is accomplished during the return pull The author might have added that the chain-saw action is continued during the process of feeding The second article, by Mr L B Walton, deals with the microscopic fresh-water annelids of the family Naididæ obtained at Cedar Point, Ohio

To the October *Zoologist* Mr R B Lodge contributes an interesting article on pelicans in Eastern Europe illustrated by the reproduction of a group of *Pelecanus crispus* on an island in an Albanian river In the case of *P onocrotalus* the parents have been stated to feed their young from the pouch, but in the species observed by the author the young birds were seen to thrust their heads into the parental throat much below the opening of the pouch, thus resembling young cormorants The nests were generally in groups of six or eight, the majority mere flat rings of sticks on the ground, but a few large structures of sticks some 2 feet in height, and very similar to cormorants' nests In a second article Mr Harvie-Brown discusses the best method of identifying the nests of the various species of wild ducks by means of the down with which they are lined, and shows that exact observations are necessary before our information on this subject can be regarded as anything near complete The past history of the kite in Somerset forms the subject of a communication by Mr F L Blathwayt, while Mr B F Cummings discusses Goldsmith's qualifications as a naturalist In the "Notes" column Mr Harvie-Brown is enabled to announce, from the evidence of notes and a sketch communicated by the Duchess of Bedford that the "sea monster" recently seen in Loch Broom, on the Cromarty coast was almost certainly a basking-shark

GUMMOSIS of sugar-cane plants forms the subject of Bulletin No 3 issued from the pathological division at the experiment station of the Hawaiian Sugar Planters' Association The author Mr N A Cobb, was the first to ascribe the disease to a bacterium, this opinion has been confirmed and the organism has received the name of *Bacterium vascularum* Diseased plants can be detected by the presence of dwarfed shoots bearing narrow, dried-up leaves also on cutting the stems gum oozes out of the fibres, thus furnishing a convenient means of testing sets intended for propagation Some varieties were found to be immune to inoculation, and it has been suggested that immunity is correlated with acidity of the sap

A FIFTH instalment of new or noteworthy Philippine plants identified by Mr F D Merrill forms supplement III to the first volume of the *Philippine Journal of Science* *Pachycentra formicana*, an epiphytic shrub forming a new species of a Malayan genus, is characterised by bulb-like roots inhabited by ants, *Sundra supa* a leguminous tree, yields timber serviceable for naval construction, and an oil suitable for making paint and varnish Several new species of Loranthus are reported, also an Anthoxanthum similar to sweet-scented vernal grass and a Poa related to *Poa pratensis* The writer has drawn up two lists of plants the one illustrating the floral relationship between the Philippines and the Celebes, the other showing the northern element in the Philippine flora

THE curator of the botanic station in Dominica refers in his annual report for 1905–6 to the large demand, constituting a record, for young plants, the chief requests being for cacao and lime plants, a considerable number of budded orange plants, mostly of the Washington navel variety, was also supplied In the matter of

manurial experiments with cacao now extending over four years, a most striking result is noted for the plot mulched with grass and leaves from which the yield per tree is higher than from the plot manured with phosphate blood, and potash, and 77 per cent higher than from the unmanured plot

A SERIES of new African species of plants determined by various authorities appears as "Diagnoses Africanæ, XVIII," in No 7 of the *Kew Bulletin* A Cissus collected by Mr Dawe in Uganda is morphologically interesting on account of its bearing so-called "pearl-glands" that are regarded as food-bodies for ants Mr G Massee contributes descriptions of a few new fungal species from the Gold Coast and elsewhere, as well as an article on potato-leaf curl This disease is perpetuated by mycelium in the tubers or by conidia in the soil, it is also noted that the same disease occurs on tomatoes An article by Mr W J Bean relative to a visit to famous Scottish gardens furnishes a good account of the trees, especially conifers, that have been successfully grown in this northern, but by no means rigorous, climate

WE have received from the Biological Laboratories Massachusetts Institute of Technology, "A Statistical Study of Generic Characters of the Coccaceæ," by C E A Winslow and Anne F Rogers A number of characters, such as average dimensions, manner of grouping, staining reactions, vigour of surface growth, acid production in dextrose and lactose broth, formation of nitrites and ammonia in nitrate solution, and chromogenesis, were determined for 500 cultures from various habitats and tables are given showing the frequency distributions for single characters and pairs of characters These tables indicate with great clearness the extreme variability of the Coccaceæ and the impossibility of laying down hard and fast boundaries for the classification of individuals At the same time, the authors show that certain natural types are apparent when the characters of the aggregate, and not of the individual are considered e g the relative frequencies of different forms of grouping, the reaction to Gram stain, the vigour of growth the rapidity of formation of nitrites or ammonia, and the most frequent colour of the pigment formed On the whole, they find that the last-named character is of most importance, and most highly correlated with other characters The work is an interesting application of statistical methods (of a very simple kind) to the difficult problem of the classification of the bacteria

THE October number of *The Central*—the Central Technical College Old Students' Assosociation magazine—includes an interesting illustrated article by Mr Bernard Dunell on suction gas for marine propulsion Mr Dunell describes Messrs Thornycroft and Co's efforts in the direction of a satisfactory gas propelled barge and also of a launch, and the results which have been obtained The writer then goes on to describe some novelties in the construction of the engine frame and in the method of connecting the cylinder trunks to it, the object being to do away with heavy bolts, and also to make the operation of disconnecting the cylinder head as simple and as quick as possible On the question of fuel for engines up to 250 horse-power anthracite or coke is used, the reason being that a cleaner gas is obtained more readily and with a simpler apparatus than is possible with bituminous coal The writer states that Messrs W Beardmore and Co are just completing two marine gas engines and producers of 500 horse-power and 1000 horse-power respectively, and in these cases ordinary bituminous coal will be used The results on these large units will be awaited with interest both from the coal point of view and also from the "gas *versus* steam" for marine work Mr F Mann Langley's contribution on electric train lighting deals with a subject of which in a general way very little is heard Although the electric lighting of trains is now taken as a matter of course so little is known about it that the author's description of the present-day methods of the generation regulation and the switching in and out apparatus between battery and dynamo is very welcome Other papers in the same issue on the evolution of the incandescent electric lamp, by Mr A S T Akerman and single phase electric traction, by Mr I Calisch are of interest, the former especially as giving a description of the "Linolite" lamp

WE have received from Messrs A Guinness Son and Co, Ltd, of Dublin a copy of part ii of vol i of the Transactions of the Guinness Research Laboratory printed for private use The principal researches carried out at the laboratory of which Dr Horace T Brown is director and published in this part are an exhaustive investigation of the nitrogenous constituents of malt which are soluble in water, and a study of the water soluble poly saccharides of malt

A REPRINT has been received of a lecture on "The Early Use of Iron," delivered by Mr Bennett Brough before the Iron and Steel Institute at Glasgow in March and published in No 1 of the journal of the institute (pp 233–253) The lecturer summarises recent investigations of the earliest records to be found of the use of the metal An interesting account is given of the use of iron in ancient Egypt Syria India and Europe and of primitive methods of working iron which still survive in India and among the negro races of Africa

THE Nobel lecture for 1906 delivered by Prof Philipp Lenard on May 28 before the Royal Swedish Academy of Sciences has been published under the title "Ueber Kathodenstrahlen" by the firm of J A Barth of Leipzig (pp 44 price 1 20 marks) It contains an admirable historical account of the development of our knowledge of kathode rays and allied phenomena, from the time of the early experiments of Crookes in 1879 to the present day The most important stages in the investigation of the rays are clearly defined and the story of the growth of the modern electronic theory of matter is told in a manner at once comprehensive and free from technicalities The account given by Lenard of the genesis of his own experiments in this field is of no little historical value A useful chronological review of the literature comprising in all fifty-five papers published between 1860 and 1906 is appended

AN investigation of the dimorphism of calcium and barium carbonates has recently been described by H F Boeke in the *Zeitschrift für anorganische Chemie* (vol l pp 244–8, August 31) It is shown that barium carbonate when heated in an atmosphere of CO exhibits a sudden arrest of temperature at 811° This temperature, which varies only by a degree or two when the rate of heating is altered represents a true inversion point for the dimorphous carbonate The reverse change takes place less readily, but is accompanied by a marked liberation of heat, when cooled rapidly the arrest point was as low as 761° but slower cooling showed an arrest at 795° approximating towards the temperature of the sharply defined arrest point in the heating curve In the case of

calcium carbonate there is a fairly definite temperature, $470° \pm 3°$ C., at which arragonite passes into calcite, but the change in this case is not reversible, and even at low temperatures calcite appears to be the stable, and arragonite the labile form.

MESSRS. F. DARTON AND CO., Clerkenwell Optical Works, have sent us a copy of the latest issue of their list of electrical novelties. The catalogue may be commended to the attention of those who are interested in the application of electricity to domestic, medical, and other purposes.

MESSRS. F. E. BECKER AND CO., Hatton Wall, London, have submitted for our inspection a specimen of their "Nivoc" patent stencil. The stencil is designed to assist young students of science in making drawings of apparatus, and will be found of service for this purpose. At the same time the adoption of stencils of this kind will deprive pupils of the practice necessary to enable them to develop the power of rapid, unaided sketching which, as Huxley long ago pointed out, is essential to the student of science.

A SECOND edition of Prof. A. E. H. Love's "Theoretical Mechanics: An Introductory Treatise on the Principles of Dynamics" has been published by the Cambridge University Press. The first edition of the work was reviewed at length in our issue for June 23, 1898 (vol. lviii., p. 169). It is only necessary to state that the changes which have been made in the present edition are for the most part of the nature of a re-arrangement of the order of the material. The consequence is that the theory has been presented in a less abstract fashion, and long preliminary discussions have been avoided.

A SECOND edition of the late Prof. P. Drude's "Lehrbuch der Optik" has just been published by Mr. S. Hirzel, Leipzig. The text has been revised, and forty pages have been added to the book in order to bring under consideration the work in magneto-optics and related subjects done since the original edition appeared six years ago (see NATURE, October 18, 1900, vol. lxii., p. 595). The manuscript of the new edition was completed and partly printed before Prof. Drude's lamented death, but Mr. E. Kiebitz has seen it through the press. The work has now an index.

THE twelfth volume of the new series of the *Reliquary and Illustrated Archaeologist* has now been published by Messrs. Bemrose and Sons, Ltd. It consists of the four quarterly numbers issued during the present year. The first of these parts includes a contribution by Mr. J. Patrick to the series of papers dealing with the sculptured caves of East Wemyss, in which the Factor's Cave is described. The April number contains an illustrated article by Mr. R. Quick entitled "Notes on the Evolution of the Means of Transport by Land and Water." The most primitive means of transport by land is stated to be by means of tent poles and skin tents, but it would be hard to prove that this method was primitive either in time or in culture, especially as the author credits "prehistoric man" with "a conveyance of logs of wood bound together by withes and carried in the hand somewhat in the manner of the Chinese sedan chair." The July number includes two interesting papers by Mr. J. Charles Wall on Lastingham, one, "Pure Norman," describes the unique example of a pure Norman crypt free from any intrusions of later architecture, and the other, "Lastingham Relics," tells of some of the treasures, mainly the sculptured stones, to be found in the crypt. The concluding part is perhaps of less interest to the man of science. It contains, with other papers, an account by Charlotte Mason of the characteristics of Blythburgh and its church, and a short paper by Sophia Beale on the evolution of the ancient lamp.

OUR ASTRONOMICAL COLUMN.

THE CALORIFIC RADIATION OF THE SUN.—Further results relating to the intensity of the solar calorific emissions are published in No. 17 of the *Comptes rendus* by MM. Millochau and Féry. Using the instrument described in their former note, and considering only the centre of the solar disc, they obtained measures at Meudon (altitude = 150 m.), Chamonix (altitude = 1030 m.), and the summit of Mont Blanc (altitude = 4810 m.). Accepting the emissive power as being equal to unity, these gave 4820°, 5140° and 5560°, respectively, when standardised by the electric furnace. All these measures were obtained when the sun was near the zenith, and the observers give a table showing the hourly variation of the apparent temperature from 8 a.m. to 6 p.m.

The maximum observed temperature on the summit of Mont Blanc was 5590° absolute, and, roughly correcting for the atmospheric absorption, this gives the final result as 5620° absolute.

THE SYSTEM OF 61 CYGNI.—In No. 4128 of the *Astronomische Nachrichten* Prof. Barnard discusses a series of measures of the double star 61 Cygni which he made on 144 nights between August 7, 1900, and November 12, 1904. These measures were undertaken for the purpose of testing Dr. Wilsing's hypothesis as to the existence of an unknown dark body in the system of this star. This observer found that his photographic measures indicated an apparent periodic oscillation in the distance between the two components of about 0".3, taking place in twenty-two months. If this oscillation were real its effect on the measures of the parallax of this star would be considerable, and might account for the large differences already obtained by various observers.

Prof. Barnard's results do not, however, confirm the hypothesis, although the observations extended over twice the interval of Dr. Wilsing's supposed period. The distance between the two components does not appear to be affected by any periodical variation, and only in one case does the distance difference exceed the mean by so much as one-tenth of a second of arc. It seems evident, therefore, that some cause other than that of a disturbing body will have to be found for the differences observed by Dr. Wilsing.

THE CAPE OBSERVATORY.—In his report of the work performed at the Cape Observatory during the year 1905, Sir David Gill states that the two underground azimuth-marks of the new transit circle are now working satisfactorily, and that the observations with this instrument show a systematic diurnal variation of azimuth amounting to about +0.02 second. When the observations of circumpolar stars are sufficiently discussed to determine the absolute variation of the azimuth-marks, it seems possible that these may prove sufficiently stable to permit of the determination of the horizontal component of Prof. Chandler's change of latitude. The automatic arrangements for regulating the pressure and temperature inside the sidereal clock-case are now perfect, the temperature never varying from 75° F. by more than one-tenth of a degree. The work for the Astrographic Chart and Catalogue was nearing completion at the end of 1905, and during that year 148 catalogue plates, containing 1944 standard and 112,080 other star images, were measured.

MINOR PLANETS.—In No. 4128 of the *Astronomische Nachrichten* Dr. Bauschinger publishes the numbers which have been allotted to the recently-discovered minor planets. From this list we see that the total number, up to June 21, 1906, was 601, and that thirty-two new ones were discovered between July 30, 1905, and that date, mostly at the Heidelberg Observatory. The same publication also contains a list of the names allotted to various minor planets between No. 459 and No. 562.

DESIGNATIONS OF NEWLY-DISCOVERED VARIABLE STARS — The permanent designations allotted to recently-discovered variable stars by the Commission of the A G Catalogue of Variable Stars are published in No 4127 of the *Astronomische Nachrichten* The table given also shows the position for 1900, the precession corrections, and the range of magnitude of each object

THE BOLOGNA OBSERVATORY —We have received from the director of the Bologna Observatory, Prof Rajna an interesting account of the history of the observatory of its present condition, and of a projected re-establishment on a new site Founded in the year 1712 the observatory was a prominent one in the astronomical world at that time, but at the end of the eighteenth century a decadence set in and, with the exception of the period 1855–1865, when Respighi was director, has continued ever since The instruments are out of date or incomplete, and the only work prosecuted is the computation of ephemerides Prof Rajna has, however, elaborated a scheme whereby the observatory might be installed in an existing building and re-fitted with new instruments at an estimated cost of about 147,000 lire (about 5800*l*) and to this end appeals for help in carrying out his project

RESEARCH IN INDIA[1]

IT must be confessed that the Englishman at home takes little interest, other than political, in his Indian Empire The fact has been noticed by the Hindus themselves We do not compare favourably with the Dutch, for example, who are keenly interested in every aspect of their possessions in the East Yet the scientific importance of India (a big slice of the globe comes under the name) is in many ways unique, and to the sympathetic and imaginative mind its varied yet homogeneous population supplies an inexhaustible fund of suggestion for the study of man Much has been done, sporadically since the days of Sir William Jones but scientific research in India has never been adequately organised The antiquities and languages of India have received comprehensive attention but the most remarkable religion of the world has depths still unfathomed, the institutions and social habits of the people are not yet fully understood important documents like the Tantras still remain untranslated though the task is a simple one and its results would be of great value Meanwhile the Hindus are the people who thousands of years ago, said—as some think—the last word on philosophy It is curious to note how frequently the European thinker ends his course in some system long ago familiar to the Hindu 'The immobility of the East so strangely contrasting with our feverish civilisation may perhaps contain the solution of a problem which still perplexes us – how to live

The memoirs here noticed represent a varied range of research in biology ethnology the history of science palæography and religion, in which Englishmen, Mohammedans, Hindus, and a Belgian Jesuit have taken part Mr G Muhammad gives new data on the customs and traditions of the people of Gilgit a dependency of Kashmir where polo is the national game and a noble family exists claiming descent from Alexander the Great These people as others of the Hindu Kush possess a harvest ceremonial of great interest, and the present paper gives some well arranged additions to Sir George Robertson's account of the subject

The paper on the Bhotias tells us a good deal about a little-known people Their culture is partly Hindu and partly Tibetan With the exception of the Jethoras, they are tradesmen by instinct and education The system of house-connections was their business method, until the treaty of Lhasa in 1904 changed the conditions of trade The national institution of the *rambang* or village club presents features of importance for the study of similar customs In their marriage ceremonies there is a mock capture of the bride The distinction between children and adults is marked, in language and custom, by the permanent teeth After the burning of a corpse a bone is taken from the pyre and placed with much ceremony in what are known as "ghost boots," while advice is given to the departed spirit as to the road he has to take

The most considerable of these papers is that by the late Father Dehon, S J , a missionary who knew the Uraons well He might have compiled a valuable monograph on the people with whom he had worked for so many years had he lived His notes reveal a liberal and scientific mind and contain much new and already elaborated information to supplement Dalton and Risley The Uraons or Oraons are one of the most interesting branches of the so-called Dravidian race One or two details will show what the reader may expect to find in the paper More than evil spirits they fear the evil eye and the 'evil mouth' and the *palkhausna* rite to obviate the evil results of envy is in constant use Father Dehon is particularly complete and lucid in his account of their theistic and spiritualistic beliefs Each dead man has two shades a light and a heavy, the latter goes to *Markha* (heaven) the former remains among the living Their ancestor worship is full of pathos and affection Human sacrifice, the author assures us still occurs in spite of the vigilance of the authorities Waifs and strays tramps and strangers, are the victims and the object of the sacrifice is to promote the success of the crops The susceptibility of these natives to hypnotic influence is remarkable, and considerable use of this peculiarity is made in their religious practices We are even told that 'in a Mission School in Chota Nagpur every time the boys sang and beat the *tomtom* together they constantly fell into trances and would run like cats along the rafters of the school and do all kinds of wonderful things ' In the *dhumkuria* or dormitory in which the village boys sleep there is an organised system of bullying the object of which is to make them hardy members of society What would our educationists say to this? The *panch* is the whole community represented by the older members and forms their republican chamber There is a proverb repeated on all important occasions 'above God below the *panch* '

Two papers owe their material to the late Tibetan expedition Some Tibetan scrolls from Gyantse contain interesting accounts of Buddhist saints but do not seem to add anything new Mr Francke argues that the beautiful Tibetan script is derived from the Kashgar Brahmi characters To one whose acquaintance with the ordinary Devanagari Sanskrit alphabet is but recent the author seems to make out a good case for his theory

Mr Stapleton's study in primitive chemistry is extremely interesting He traces the connection between savage magic and mediæval alchemy with special reference to the process of obtaining sal-ammoniac from burnt hair His other paper with Mr Azo deals with the materials and apparatus of alchemy in the eleventh century and is worth the attention of chemists who are interested in the origins of their science It is chiefly written round an Arabic book *Inter alia* he shows that importance was attached to weights in chemical experiments 700 years before the time of Black and Lavoisier

Marine zoologists will find new examples of Pedunculata described and illustrated in Mr Annandale's paper The Ashrafpur copper plates reveal the existence of a hitherto unknown line of Buddhist kings in east Bengal

There are some good plates in the volume The press correcting is at times annoying there are too many misprints, and it is confusing to find two papers each commencing on p 93 one ending on p 119 the other on p 127 while the succeeding paper begins on p 121

A ERNEST CRAWLEY

[1] *Memoirs of the Asiatic Society of Bengal*, 1905 6 Vol 1 No 1 pp 1–23, 'On certain Tibetan Scrolls and Images lately brought from Gyantse," by S C Vidyābhūṣana No 2 pp 25–42, "Sal ammoniac a Study in Primitive Chemistry," by H E Stapleton No 3, pp 43 45 'The Similarity of the Tibetan to the Kashgar Brahmi Alphabet, by A H Francke (with 5 plates). No 4 pp 47–70, "Alchemical Equipment in the Eleventh Century, A D , by H E Stapleton and R F Azo (with 1 plate). No 5, pp 73–84, "Malaysian Barnacles in the Indian Museum with a List of the Indian Pedunculata, by N Annandale (with 1 plate) No 6, pp 85–91, "Ashrafpur Copper plate Grants of Devakhadga, by G M Laskar (with 1 plate). No 7, pp 93–127, "Festivals and Folklore of Gilgit," by Ghulam Muhammad No 8 pp. 93–119, "Notes on the Bhotias of Almora and British Garhwal, by C A Sherring No 9, pp 121–181, "Religion and Customs of the Uraons,' by P Dehon, S J (Calcutta, 1905 [1–5, 7] 1906 [6, 8, 9]). (Price —1, 2*s* 3*d* , 2, 1*s* 6*d* 3, 2*s* 10*d* , 4, 2*s* 3*d* , 5, 2*s* 3*d* 6, 10*d* , 7, 2*s* 10*d* 8, 2*s* 9, 2*s* 10*d*

NATURAL HISTORY IN NATAL

WE have the pleasure of congratulating the trustees, and the colony generally, on the appearance of the handsomely illustrated report mentioned below[1] which inaugurates what is practically a new era as regards scientific progress in Natal. As the museum was only opened to the public on November 30, 1904, the report is devoted almost entirely to an account of the building and the condition and extent of its collections at that date. It is, however, satisfactory to learn that, under the direction of Dr. E. Warren, the institution is already of considerable educational value to the colony, and that it promises to be still more so in the near future. One of the questions which, as in all such cases, exercised the minds of the authorities at starting was whether the museum was to be solely devoted to local exhibits or was to contain a representative general series. So far as zoology is concerned, the question has been decided in favour of the latter alternative, and it has been also settled that local and foreign specimens are in the main to be exhibited in one series. Whether these are the most satisfactory conclusions it is not for us to say; but we may at any rate welcome the announcement that the antelopes and other ungulates, which form the most striking—and at the same time a fast disappearing—feature in the South African fauna, are to have a separate gallery for their display. Good progress has already been made with this portion of the collection, and, if we may judge by a photograph of one portion of the "ungulate room," the mounting of the specimens, as exemplified by a group of waterbuck, and the ample amount of case-room provided, will render this part of the collection as attractive and striking as its representative in our own Natural History Museum. We are glad to see that the example set by the latter institution of mounting the specimens either on artificial ground-work or on earth-covered (in place of polished sycamore) stands has been adopted by the director, and we may express the hope that no efforts will be spared to render this series as complete as possible before it is too late.

As regards the educational function of the museum, it was decided to defer the establishment of lectures and classes until such time as a special commission had finished its sittings and issued its report; but it is proposed that the institution should eventually take its share in a large scheme of technical education in such subjects as zoology, botany, and geology.

In issuing a new scientific serial under the title mentioned below[2] the authorities of the Natal Museum are undoubtedly doing good service to the cause of biology and geology throughout the world, more especially as one of its great features is the full and sufficient illustration of the new species from time to time described. In this latter respect the trustees are setting an excellent example of wise liberality, for one of the crying evils of the present day is the continual flood of descriptions of alleged new forms with inadequate or no pictorial illustrations. By means of the large number and superb execution of the plates accompanying the issue before us naturalists will be able to form their own opinions of the validity of the new species described, and it is sincerely to be hoped that no financial conditions will be allowed to bar the maintenance in succeeding issues of the high standard adopted in the first number. There appears, however, to be every reason to hope that the present standard will be maintained, as it is stated in the introduction that such is the express wish of both the trustees and the publishers. It is expected that about two parts (of variable size) will be published yearly. From the number of illustrations the price is naturally somewhat high (10s. in the case of the present issue).

The editor has been fortunate in securing for his opening article a communication on South African fishes, in the course of which Mr. C. T. Regan describes a new South African beaked shark differing from typical species of Pristiophorus in possessing six in place of five gill-slits. This difference is regarded by the author as of generic value, and the new generic term Pliotrema is accordingly proposed. Several other new fishes are described and illustrated by Mr. Regan. With the exception of one on the abnormally elongated and spirally twisted hoofs of an African sheep, the other articles are devoted to invertebrates. Mr. E. A. Smith, for instance, contributes a list of South African marine molluscs, lengthened by the addition of some new species of his own, while other writers discourse on Natal zoophytes and divers other representatives of the African marine fauna, and the editor describes a "Myxosporidium" from an African rotifer.

Once more we repeat our sense of the obligations under which biologists and geologists are placed by the liberal and progressive policy of the trustees of the Natal Museum.

R. L.

[1] First Report of the Natal Government Museum for the Year ending December 31, 1904. Pp. 185; illustrated. (Pietermaritzburg: P. Davis and Sons, 1906.)

[2] "Annals of the Natal Government Museum." Part 1, June 1906. (London: Adlard and Son.)

WEIGHTS AND MEASURES REGULATIONS.[1]

UNDER the Weights and Measures Act, 1904, the Board of Trade is required to make regulations with respect to weights, measures, and weighing and measuring instruments used in trade. These regulations, when made and laid before Parliament, are to be of general application throughout the United Kingdom, and will have the force of an Act of Parliament. The Board of Trade has accordingly prepared a code of regulations, which are, however, at present in draft form only.

These new regulations are a considerable improvement on the various local codes which they are intended to replace on January 1, 1907. They are much more definite and more readily understood than the somewhat oracular Model Regulations of 1890. The principal innovations are the abolition of cased weights, a requirement that pewter measures shall contain at least 80 per cent. by weight of tin, the restriction of the linear dimensions of dry measures of capacity to certain specified limits, the prohibition of wooden measures turned from the solid block, and the exclusion of counter weighing machines constructed on the accelerating principle. All these are steps in the right direction, and it is not anticipated that they will entail any injustice either to manufacturers or tradesmen.

A provision which will possibly meet with some objection is clause 23, which requires that the weighing instruments used by chemists and tobacconists shall satisfy the requirements of class A. This regulation, in conjunction with No. 87, would appear to prohibit these traders from using counter weighing machines and to require them to use either beam-scales or balances. There may be some exemption for machines already in use, but the important clause (No. 19) dealing with this matter is unfortunately rather loosely worded, and admits of different interpretations. It is by no means certain, however, that this prohibition, although virtual and indirect, is not *ultra vires*, as the power conferred on the Board of Trade by section 5 (1) (*d*) of the Act relates to limits of error, not to forms of weighing machines, and would appear to be exceeded here. Bearing in mind the fact that the most vexatious regulation of the 1890 code was one which the law officers of the Crown subsequently declared to be invalid, it would be a matter for regret if the excellent series of regulations now under consideration were marred by the inclusion of any provision of doubtful legal sanction.

The limits of error tolerated do not differ much from the old allowances. As regards the tests prescribed by the department under section 5 (1) (*c*) of the Act, the mode of applying these might be more precisely defined. For instance, a 1 lb. balance is required to be correct within 0.2 grain, and unless the inspectors are to be provided with standard weights of unusual accuracy it would be only fair to prescribe strictly the method of testing to be observed in such a case. The regulation on this subject (No. 85) appears somewhat vague.

In framing these proposed regulations the Board of Trade has had the advice of a committee of experts presided over by Mr. W. R. Bousfield, K.C., on which the department was represented by Major P. A. MacMahon, F.R.S.

[1] "Draft Board of Trade Regulations with respect to Weights, Measures, and Weighing Instruments." (London: Wyman and Sons, 1906.)

THE INTERNAL ARCHITECTURE OF METALS[1]

IT has been cynically remarked that to deliver a successful scientific lecture to a cultured audience it is necessary to divide the lecture into three parts The first part should be understood both by the audience and the lecturer, the second part by the lecturer and not by the audience, and the third part neither by the audience nor by the lecturer

If the foregoing dictum were true, the speaker found himself in a paradoxical position The object of the discourse was to make the subject under consideration as clear as possible throughout, hence the more nearly this object was achieved, the more unsuccessful the lecture The title of the discourse might seem to some far-fetched, since, superficially, a bar of polished brass or steel apparently presented the archetype of a homogeneous solid Any such idea, however, must in a few moments be dispelled. Taking a section of pure gold, or at any rate of gold of a purity of 99.995 per cent, this, when polished and etched presented under a low power of the microscope large allotrimorphic crystals, the etching figures of which exhibited varying orientation in different crystals Hence (see Fig 1) one crystal might appear black, another show the brilliant yellow of gold and a third exhibit middle tone All these were purely optical effects In the

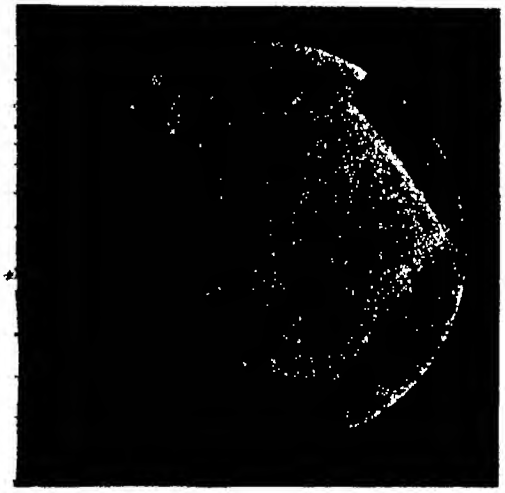

FIG 1—Gold

black crystal the orientation was at such an angle as to reflect the light entirely outside the objective, whilst, going to the other extreme, the gold-coloured crystal had a molecular orientation which reflected the light entirely into the objective It was well known that the addition of one or two tenths per cent of the metal bismuth to gold produced a surprising mass brittleness which naturally led to the enunciation of theories to account for so remarkable a phenomenon

Twelve years ago the theory which commanded a general acceptance, and at that time reasonably so, was that the small quantity of bismuth was incapable *per se* of producing so profound a mechanical change as to convert one of the most ductile of metals into a mass possessing an almost glassy brittleness Therefore, the metal bismuth must act indirectly, its presence determining the maintenance of the molecules of gold in a brittle allotropic modification

In 1896 there was published in *Engineering* from the laboratories of the Sheffield College an unambitious research recording the discovery of eutectic cements which to a considerable extent altered the whole trend of metallurgical thought

[1] Abstract of a discourse delivered at the Royal Institution on Friday, February 23, by Prof J O Arnold

Fig 2 shows a micro-section of the structure of gold to which 0.2 per cent of bismuth had been added The microscope had at once explained the hitherto mysterious action of bismuth It indicated clearly that the small quantity of bismuth alloyed with a definite amount of gold forming a constituent having a much lower freezing point than the main mass Hence, when crystallisation set in during solidification from a series of centres, the "eutectic" or constituent last fluid was expelled to the exterior of each crystalline grain of pure gold, thus enveloping each crystal in a membrane of gold bismuth alloy having a much higher coefficient of contraction than the crystal itself Hence, during cooling, the gold-bismuth alloy, which may be regarded as the mortar of the structure, to a considerable extent detached itself from the crystalline grains of gold which may be regarded as the stones of which the mass is built up In the micrograph Fig 2 the stones of tough gold are represented as white whilst the mortar of gold bismuth eutectic is shown as dark thick enveloping membranes These membranes become pasty well below a red heat and it was proved that at 400° C the mass could be powdered in a mortar the crystalline grains of pure gold becoming detached from the feeble alloy cementing them together One of these crystalline grains exhibited no signs of the brittleness of the mass from which it was thus detached but was readily beaten out into gold leaf in the ordinary manner

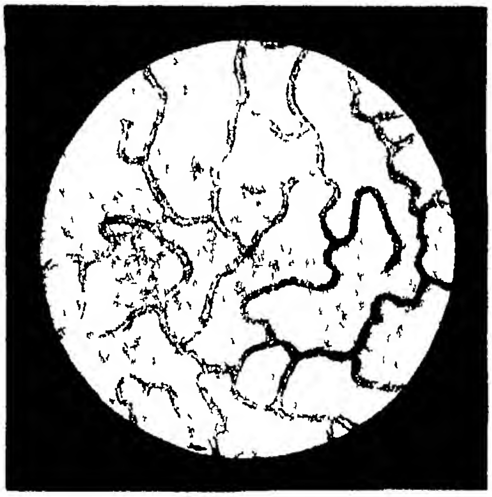

FIG 2—Gold containing 0.2 per cent of bismuth

Passing from gold to brass it was proposed to diverge from the abstract to the concrete and to show the value of the application of the science of metallurgy to practical problems connected with mysterious failures in marine engineering

A notable case in point was the explosion of the brazed copper main steam-pipe of the s s *Prodano* in calm weather off the Kentish Knock at a pressure about one tenth of that to which it had been previously tested In this case the microscope was again successful in clearly indicating the nature of the electrolytic decay, under certain conditions of brass used in naval architecture In this connection a familiar phenomenon is the decay of Muntz metal bolts exposed to the action of bilge water Such bolts break suddenly and present a distinctly coppery fracture A micrographic examination of such bolts usually revealed a minor area of undeteriorated brass and a major area of deteriorated brass—that was to say brass which had been more or less dezincified, an expression which meant in other words that the mass had become transformed into rotten, spongy copper

Brass often consisted of two constituents namely a ground mass of true brass of formula Cu_2Zn and a eutectic corresponding to the formula $Zn\,Cu$ Upon a mass so constituted a feeble saline electrolyte attacked in

the first instance the constituent rich in zinc, whilst the constituent rich in copper assumed an electronegative position, acting, of course, as the kathode of the couple.

But when the eutectic had been transformed into spongy copper, the latter assumed the electronegative position and the true brass became the anode, hence gradually transforming the whole mass from Muntz metal into spongy copper. In the case of the *Prodano*, the electrolyte was proved beyond all doubt to have consisted of fatty acids due to the use of improper lubricants. Little by little the brazed seam was cuprified until the junction became so weakened that at a pressure of only 130 lb. per square inch the port main steam pipe opened for a space of 6 feet and consigned four men to an agonising death.

This research, made at the Sheffield College under instructions from the committee of Lloyd's Register, resulted practically in the abolition of brazed copper main steam-pipes and in the substitution of rolled steel ones.

Reaching the third section of the lecture, this undoubtedly must be regarded in the steel age as the most important, since it dealt with steel. Taking the base of steel, namely, pure iron, this had a similar structure to that of pure gold, but the etching figures exhibiting the molecular orientation in the allotrimorphic crystals of this metal were seldom revealed by ordinary etching.

Broadly speaking, iron was converted into steel by the addition of the element carbon, and researches made in the Sheffield College indicated that steels naturally divided themselves into three classes, namely, unsaturated, saturated, and supersaturated steels. If 0.3 per cent. of carbon were added to steel the carbon converted one third of the iron into the constituent pearlite, and in such a steel as cast the iron or ferrite frequently arranged itself into a pattern indicative of cubic crystallisation exactly comparable with the figures observed by Widmanstatten in the non-terrestrial steels called meteorites. In saturated steels just sufficient carbon approximately 0.9 per cent. had been added to the ferrite to convert it totally into the constituent pearlite, a definite mixture corresponding to the formula $(21Fe+Fe_3C)$. This definite mixture presented at least three well-marked phases having different mechanical properties determined by the state of the division of the carbide Fe_3C. These phases might be differentiated by distinguishing the involved carbide as emulsified, normal, and laminated, the latter being the pearly constituent of Sorby, presenting a play of gorgeous colours determined by the varying thickness of the lamina acting like mother-of-pearl in nature, or the interference grating in science. Through no scientific foresight, but as a matter of fact by an act of carelessness, there had been secured at the Sheffield College a section showing the transformation of pearlite into hardenite in the most perfect manner yet recorded. The two constituents, pearlite and hardenite, might humanly be described as the most important in nature, since upon unhardened and hardened steel depended the remarkable triumphs of the civil, the mechanical, and the electrical engineer.

The quartz-hard transformation product of pearlite discovered by the versatile genius of Dr. Sorby itself presented what might be termed effective and futile phases dependent upon the temperature of quenching. In properly quenched steel the accidental section before referred to showed that at a moderate temperature the transformation proceeded not suddenly, but from a series of converging centres until the whole mass consisted of the obsidian-like substance, structureless hardenite. At too high a temperature this steely obsidian developed decisive cubic crystallisation, recorded in the micro-structure by equilateral etching figures indicative of ruined steel. In supersaturated steel in the unhardened condition the cells of pearlite were environed by brilliant walls of cementite Fe_3C, which in hardened steel enveloped similar cells of hardenite corresponding to the empirical formula Fe_3C.

Of the three broad types of steel described by far the most important was unsaturated steel, a synonymous term for which was structural steel, embracing boiler-plates, ship-plates, bridge-plates, rails, and the gigantic engine parts which formed the backbone of our battleships and cruisers.

To show the enormous importance of the scientific study of this class of steel, it was well to indicate, not only its failure but after brilliant service, also that of the microscope scientifically applied.

The figure thrown upon the screen was that of a boiler, which might be described as several sorts of boiler. It was a marine boiler, a cruiser's boiler, and possibly a mad boiler—it was, at any rate, cracked. Fortunately this rupture occurred before the cruiser was put into commission, and a defect in the steel which might have resulted in a catastrophe was detected by an extra inspection after the boiler had been impressed with the Government pass mark. The chronology of the testing operations was recorded in the following table:—

Date	Nature of pressure	lb. per sq. in.
February 5	Hydraulic	228
,, 8	,,	260
,, 19	,,	305
,, 20	Steam	60
,, 21	Hydraulic	270 (burst)

The mechanical tests of the boiler-plate steel which had thus failed left little to be desired, and the same remark applies to static mechanical tests taken along the line of fracture. Micrographic tests indicated that the steel presented marked features of inferiority when compared with undoubtedly good boiler-plate steel. Superficially the matter was thus solved, but, under alternating or dynamic stress tests slightly beyond the elastic limit, the steel registered tests varying from 230 to 1292 alternations. The most disconcerting feature in these astoundingly divergent tests was that the test bars registering them were identical in micrographic structure.

At the Cambridge meeting of the British Association the lecturer suggested that these divergent tests must be associated with opposite sides of the plate subjected to varying heat treatment. The lecturer was quite wrong, and after twenty-five years' experience had failed to realise the fact that in connection with steel one must often expect the unexpected.

Remarkable failures in structural steel were commonly associated with the phenomenon called "fatigue." What was "fatigue"? Some little time ago, in an important naval trial at the King's Bench, counsel requested the lecturer to define for My Lord the meaning of this term, which had frequently occurred during the trial, and which he failed to understand. Unfortunately the lecturer also was involved in the outer darkness of My Lord on this matter, but was compelled to give "fatigue" at that time a definition which remains substantially true to-day, namely, that he regarded "fatigue" as a generic term used clearly to explain all cases of fracture which were not understood. Before venturing to suggest an explanation for these mysterious fractures for which popular blame often fell upon men who were doing their very best, he would ask his hearers to imagine that that small cloud no bigger than a man's hand, now hovering over the North Sea, should burst in storm, and that our armour, our guns, and our armour-piercing shells should be put to the stern implacable test of actual warfare. Supposing our guns were faulty, our shells failed to penetrate the armour of the enemy, our armour was incapable of protecting the gallant inmates of our battleships, assuming this hypothesis, which the lecturer believed to be totally untrue, what would all this mean? It would mean that the internal architecture of British wrought steel was all wrong, and the interesting question thus arose, who were the men responsible for the internal architecture of these metals? The lecturer knew them well. They were grave-eyed men with set mouths, who week after week, month after month, and year after year lived and moved, and had their being, and sometimes died, amid the flare of gigantic furnaces and the rattle of Titanic rolls, steadfastly working upon those metals which formed Britain's first line of defence, and to-night on behalf of these inarticulate men the lecturer confidently asked his distinguished audience to exclaim in their hearts, "These men have deserved well of their country."

Reverting to the remarkable and disconcerting fact that two pieces of the faulty boiler-plate steel of identical structure, so far as could be seen by the microscope, gave astoundingly different results under dynamic stresses, the

lecturer put forward as a tentative hypothesis the theory that, underlying the gross and visible micro-structure of the steel, there existed a molecular structure, which in the present state of knowledge could not be detected, except in rare cases, by the microscope. It was suggested that this molecular structure was brought about by improper heat treatment developing in the ferrite from a series of centres well developed mineral cleavage. On the circumference of these centres existed areas in which the molecular cleavage was less perfectly developed, and beyond these were the areas of good steel in which the cleavage lines were extremely imperfect. It was then easy to conceive that the plane of dynamic fracture in a perfectly developed cleavage area might give the remarkably low record of having endured only 230 alternations as in the table previously exhibited on the screen, whilst a test-piece in which the plane of fracture went through an area of good steel free from what might be called cleavage disease might readily endure 1200 alternations before breaking, and a third test-piece from the middle zone of somewhat developed cleavage might endure, say, 700 alternations. This theory, at any rate, was in accordance with the mechanical facts which had been presented. Another step towards the experimental verification of this hypothesis would be to prove that iron was a veritable mineral as capable of exhibiting geometrical cleavage as was, say, fluor-spar or Carrara marble. Fortunately the lecturer

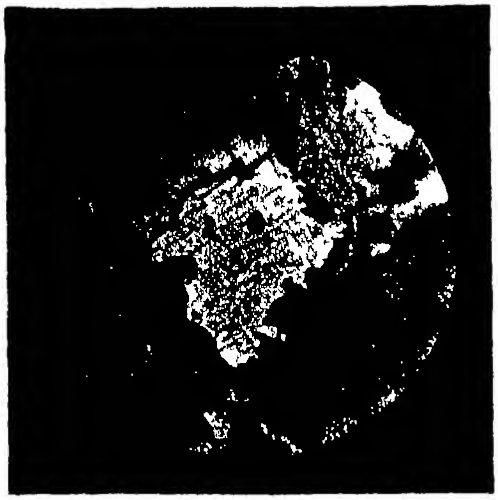

FIG. 3.

found himself in a position, by what might be called a million-to-one chance, clearly to prove that iron could possess absolutely perfect mineral cleavage parallel to the faces of the cube. This discovery came in no heroic form from the swift-moving machinery of a destroyer or in connection with metal forming the stupendous engines of a battleship, but in connection with a wrought-iron bolt literally forming part of a common or garden gate-post. This fractured under the taps of a hand-hammer during repairs, and one of the crystals cleaved exactly at right angles to the axis of the bolt, and consequently when the fractured end was cut off in the lathe for examination it was found at right angles to the axis of the microscope, exhibiting the wonderfully perfect cubic cleavage delineated in Fig. 3.

Metallurgists had now arrived at a deadlock. The microscope, after rendering great services, had in its turn broken down, mainly owing to the fact that optical examinations associated with transmitted light could not be applied to opaque objects, and in more senses than one the scientific metallurgist could not yet see through steel. Nevertheless, he must endeavour to tear down this mysterious veil or in some way get behind it, and in the lecturer's opinion the resources of science in connection with steel metallurgy were not yet exhausted.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. A. C. SEWARD, F.R.S., has been appointed professor of botany in the University of Cambridge in succession to the late Prof. Marshall Ward.

WE learn from *Science* that Mr. J. A. Creighton, one of the founders of Creighton University, Omaha, Nebr., has presented to that institution two buildings worth about 100,000*l*.

AN interesting educational development in Manchester is recorded in the *Electrician*. The Corporation of that city has just decided to take approved students from the School of Technology into the electricity works for a three years' training, giving them a certain small but increasing salary during that time. This privilege is to be restricted to sons of Manchester ratepayers.

IT is announced in *Science* that Mr. A. C. Chapin has given Williams College an additional gift of 10,000*l*. to be used by the trustees without restriction, and that Mr. C. T. Barney has given 2000*l*. to the college. It is stated that the fund for Oberlin College, as completed, amounts to 100,300*l*. This includes the following funds:—25,000*l*. for a new library building given by Mr. Andrew Carnegie, 20,000*l*. for library endowment, 20,000*l*. from an anonymous donor in Boston for the increase of salaries of teachers in the college and seminary, and 30,000*l*. for miscellaneous purposes. The gift of the Boston donor enables the trustees to increase by 40*l*. the salaries of twenty-four full professors.

THE following announcement appears in the volume of Regulations (Cd. 3201) just issued by the Board of Education containing the prospectus of the Royal College of Science, London, with which is incorporated the Royal School of Mines (session 1906–7):—"It is probable that as a result of the investigation made by the departmental committee lately appointed by the President of the Board of Education various changes will be made in the organisation and relations of the Royal College of Science, including the Royal School of Mines. The Board therefore give notice that the arrangements detailed in this prospectus are subject to such alterations as they may determine in respect of the classes for the college session 1906–7 and of courses of study in future."

THE last report of the Scotch Education Department dealing with secondary education in Scotland directs attention to a new departure in the method of awarding leaving and intermediate certificates. The report states that last year the aid of the teacher was actively enlisted in determining the question of success or failure, and that much weight was attached to a pupil's school record, as properly attested by his teacher, in the allocation of school bursaries. The secretary puts it on record that events have completely justified the confidence of the Department. The teachers, as a body, have risen to the responsibility that was placed upon them. Of course there were cases of miscalculation by the teacher, but these were rare exceptions. The success which this Scottish experiment has met in the direction of humanising the methods of appraising knowledge and intellectual training, with the object of selecting the best pupils, should encourage those responsible for examinations south of the Tweed to increase their efforts to abolish the mechanical character of many of the current tests to which young students are subjected.

THE annual general meeting of the Association of Teachers in Technical Institutes was held on Saturday, October 27. Mr. W. J. Lineham, president, occupied the chair, and Mr. V. Mundella was elected president for the ensuing year. The following resolutions were adopted:—(1) That the association urges the desirability of attendance at evening continuation schools between the ages of fourteen and sixteen being made compulsory upon all not in attendance at elementary or secondary schools. (2) That in view of the generally inadequate provision made in the present scholarship schemes of local educational authorities for the needs of scientific technological and trade students, the local branches of the association be instructed to consider what amendments of local scholarship schemes

are necessary to meet the needs of such students, and to press such amendments upon the local education authority with the view of remedying the defects indicated (3) That the attention of the technological branch of the Board of Education be directed to the desirability of recruiting the staff of inspectors from those with experience in technological teaching

By the will of the late Mr John Daglish, Armstrong College, University of Durham, will eventually receive about 45 000*l* After the payment of claims on the estate and certain legacies, the whole of the testator's property is placed in the hands of trustees upon trust to pay the income to the testator's widow during her life Subsequently 5000*l* is to be paid to Armstrong College for the foundation and maintenance of a travelling fellowship in mining and the associated subjects to be called the 'Daglish Fellowship' As certain annuities successively fall in, the income is to be paid to Armstrong College for its general purposes, among which three, in the order named are to have precedence The first of these is the augmentation of the principal's stipend to 1500*l* a year, the second is the augmentation of the stipend of the professor of mining to 800*l* a year, and the third the augmentation of the stipend of the professor of agriculture to a similar sum When all the annuities have fallen in, the trustees are to hand over 30,000*l* to the college to be invested for its general purposes The income of the residue is to be paid to Armstrong College, to be applied as ordinary revenue, until the council of the college shall erect as one scheme further buildings costing not less than 20 000*l*, and shall have received from legacies or subscriptions 10 000*l* applicable to such buildings

THE new buildings of the King Edward VII Grammar School at King's Lynn presented by Mr (now Sir) W J Lancaster, were opened by the King and Queen on Monday The Town Council of Lynn provided the site for the buildings which with the foundations cost more than 43,000*l*, and include chemical and physical laboratories and lecture-rooms In the reply of the King to an address of welcome presented by the Mayor of Lynn, the words occur —"The occasion of our presence here to-day shows that you are not content with the traditions of the past however worthy of remembrance those may be, but through the liberality of an old pupil of the school which bears my name the new buildings of which I am now about to open, are determined to keep abreast of the times and are conscious that it is only by a thorough education that the younger generation can hope to prove successful in later life" An address was also presented by the governors of the school and the King read a reply in the course of which he said —"You are aware of the deep interest which I have always taken in the public institutions of the county of Norfolk and in all schools established for the purpose of imparting higher education It is not easy to over-estimate the far-reaching benefits of the tuition obtained in such an institution as this You, as governors of the school will, I feel sure exercise the most solicitous care in the direction of the studies of your pupils that they may be able to face the stress of life with an intellectual equipment such as will enable them to hold their own in the world and bear their part in its work and duties with efficiency and to the benefit of others nor will I feel confident, the higher teaching of morality, truth, and self-respect be neglected"

THE annual report of the council of the City and Guilds of London Institute for 1906 has reached us In the last report the council directed attention to the financial position in which the institute had been placed by the reduction of the contributions of the Corporation and the Mercers' and Fishmongers' Companies, but in the present report the council is able to state that the Corporation has reverted to its previous contribution of 500*l* —the amount in 1904 having been reduced to 400*l* —and has decided to contribute a similar sum for each of the following five years The Mercers' Company has also reverted to its original contribution of 2000*l* The Vintners' Company has increased its contribution, and the Saddlers' Company has withdrawn conditions previously attached to its subsidy The Fishmongers' Company has yet to rescind its resolution to reduce its contribution from 4000*l* to 2000*l*. The extracts printed in the volume from the examiner's reports should be carefully read by teachers and students Apart from the value of the suggestions and criticisms they contain, they afford an instructive insight into the mental capacity of the artisans, who are training to become skilled operatives in many of the chief branches of industry They show very clearly where the preliminary education of these students is at fault, and the errors into which they most frequently fall The council remarks that from the reports furnished by the examiners it appears that, on the whole, there is a gradual but distinct improvement in the character of the students' work, and in the knowledge, intelligence, and skill which their answers and exercises display

AN address by Prof George H Mead, delivered before the Chicago Chapter Sigma Chi in March last, is reprinted in *Science* for September 28 Prof Mead states that science in the colleges of Chicago and other American universities has not the importance and popularity that it should have This is due, it is said, to the freedom of choice of studies in the preparatory schools, the scientific courses are not selected by the children at a period when the concrete subject-matter of science properly presented should be immensely more attractive than languages and abstract studies The science courses in the high school are not Prof Mead affirms, popular at the present time, nor is the money spent on them, whether in equipment or teaching staff comparable with their educational importance The result is that the majority of American students leave the universities without a grasp of the important achievements in modern thought, and without being able to interpret what they see hear and feel, by means of the splendid generalisations now known to the world Prof Mead explains the unpopularity of science in schools and colleges by the statement that scientific problems are no longer within the immediate experience of the student, and not always to be expressed in terms of that experience In addition, he says, the natural sciences are not inter-connected in the minds of the students Discussing the remedy for this misfortune, Prof Mead thinks it lies with the schools where children should be introduced to science in an intelligent manner Until this is done the colleges he maintains, should arrange introductory courses in science, in which the subject should be presented from the points of view of history and of a survey of the world of science as a whole In this way, the address contends the culture value of science would become clear and suitably esteemed

A RECENT article by Mr J L Bashford in the *Westminster Gazette* provides an interesting description of the Berlin High School of Trade, or Merchants' College, which was opened in the presence of the Crown Prince a few days ago The college has been erected by the Corporation of the Merchants of Berlin at a cost of about 166 000*l* and will be maintained entirely by the same body The State has in this instance made no grant nor did the idea of the college originate with the Education Department This Berlin school is the only institution of the kind in Germany, and is intended for merchants The aim of the teachers will be to give the students knowledge and a theoretical training Lectures will be delivered on all subjects connected with the usances of trade—exchange, banking, Stock Exchange, gold and silver standard, investment of capital, the history and technique of certain branches of industry—*e g* electricity, machines and the textile industry, book-keeping, arithmetic and insurance, trade politics, political economy, statistics social questions, the requirements of workmen in factories, the money market and its organisation in Germany, England France, and the United States of America, civil law, commercial law, and every other form of law connected with trade relations, commercial geography and commercial history Philosophical and art studies also find a place in the programme, and knowledge of foreign languages as well as knowledge of foreign countries The new college contains an aula, capable of holding about 600 persons, and nine lecture-rooms, some for forty and others for fifty 100, and 150 students, as well as a laboratory for chemistry and one for physics

FROM Continental contemporaries we note the following recent appointments:—Prof. H. Rubens, professor of physics at the Technical High School, Berlin, to be professor of physics at the University of Berlin and director of the Physical Institute; Prof. Arthur Wehnelt, professor of theoretical and applied physics of the University of Erlangen, to be a professor and departmental director in the University of Berlin; Dr. Joseph Grunwald, privatdocent at the University and the Technical High School of Vienna, to be extraordinary professor of mathematics in the University of Prague; Dr. H. Mache, privatdocent of the Vienna University, to be extraordinary professor of physics in the University of Innsbruck; Prof. Cæsar Pomeranz, extraordinary professor of chemistry in the Vienna University, to be professor of chemistry in the University of Czernowitz; Prof. Karl Zsigmondy, professor of mathematics in the Technical High School, Prague, to the chair of mathematics in the Technical High School, Vienna; Prof. Reissner, privatdocent in the Technical High School, Berlin, to be professor of mechanics in the Technical High School, Aachen; Prof. Zdenko Skraup, professor of chemistry in the University of Graz, to the chair of chemistry in the University of Vienna; Prof. Franz Streintz, privatdocent of the University of Graz, to be professor of physics of the Technical High School in Graz.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 31.—"The Viscosity of the Blood." By Dr. A. du Pré **Denning** and John H. **Watson**. Communicated by Prof. F. Gotch, F.R.S.

It is urged that the full import of a knowledge of the variations in the viscous resistance to be overcome by the blood in circulating through the capillaries and smaller vessels of the system, and the significance of such data to the more exact consideration of a large number of normal and pathological conditions, especially those of the circulatory system, have not been fully realised by either clinicians or physiologists. Experiments have been undertaken to observe the influence of the number of the corpuscles present upon the viscosity of the blood under varying conditions of pressure and temperature, the rate of flow through capillaries of different sizes under the same conditions, and the alterations caused by the additions of certain salts and other substances; one important result of the experiments was to show that the decrease in viscosity for each degree rise of temperature for a blood rich in corpuscles is considerably greater than for a blood poor in corpuscles, especially when the flow is through the finer capillaries, or, in other words, the flow of blood does not follow the fourth power of the radius as required by the Poiseuille formula. An attempt is made to indicate briefly the import of the results obtained in a consideration of the mechanism of the circulatory system. At the end of the paper an account is given of a clinical viscosimeter which the authors have devised for determinations of blood viscosities with but a few drops of blood, such viscosity determinations, it is claimed, are necessary supplements to hæmacytometer observations.

June 21.—"On the Behaviour of Certain Substances at their Critical Temperatures." By Dr. Morris W. **Travers**, F.R.S., and Francis L. **Usher**.

Traube, de Heen, and others have recently suggested that the simple theories of Andrews and Van der Waals may be insufficient to account for the changes which take place in pure substances at their critical temperatures. Their evidence appears to show that in the case of such substances as ethyl alcohol and ether the Cagniard Latour temperature is dependent on the relative volumes of the two phases, and to account for this they have suggested the existence in the system of complex molecules.

The authors have carried out investigations with ether and with sulphur dioxide, and have found that the Cagniard-Latour temperature is independent of the conditions under which the experiments are carried out. Particular precautions were taken to obtain the liquids pure and to maintain steady temperatures, the measurements of which were certainly accurate to within 0°.05.

The second part of the paper deals with the phenomenon of opalescence which is observed in pure liquids at their critical temperatures. If varying quantities of a pure liquid are heated in sealed glass tubes, provided that the liquid neither disappears nor completely fills the tube before the critical temperature is reached, the surface separating the two phases may sink and disappear near the bottom of the tube, or it may remain stationary about the middle of the tube, or, lastly, it may rise and vanish near the top. In all three cases, if the temperature is raised so slowly that equilibrium is attained without ebullition of the liquid phase, the contents of the tube become opalescent at a temperature slightly below that at which the surface vanishes, the effect being similar to that produced by the action of oxidising agents on a solution of sulphuretted hydrogen. When the surface is falling the opalescence appears in the space below it, and when the surface is rising, in the space above it. In either case the opalescence is confined to the space in which it first appeared by the moving surface, and its intensity is inversely proportional to the volume it occupies. Although it is fairly evenly distributed through the space it occupies, it is usually more intense very near to the surface, and when the latter disappears gradually becomes diffused through the whole tube.

In the case where the surface appears to remain stationary, the tube appears slightly and evenly opalescent throughout its whole length, and if, when this is the case, the volume of the space containing the substance is increased or decreased, opalescence appears below or above the surface itself, and its intensity is inversely proportional to the space it occupies. The effect persists over a finite range of temperature. In the case of sulphur dioxide it sets in at 0°.1 below that at which the surface vanishes, attains a maximum at about 0°.05 above it, and completely disappears at a temperature 0°.1 higher. In the case of ether the effect persists over about 2°.

The conditions necessary for the existence of complexes in a liquid-vapour one-component system in the neighbourhood of the critical temperature were given by Donnan at the British Association in 1904. He suggested that at the critical temperature the interfacial tension becomes zero for ordinary values of the radius of curvature, but remains positive for very small values, for which it does not become zero until the critical temperature is passed. Hence it may be assumed that at temperatures slightly below the critical the interfacial tension is greater for very small radii of curvature than for ordinary curvatures. If over a range of temperature including the critical temperature, limited above by the temperature at which the interfacial tension for very small curvatures becomes zero, and below less sharply, small non-molecular aggregates can be formed, it follows that these will be differentiated from either the liquid or vapour phase, and will have a stable existence. To such aggregates is attributed the phenomenon of opalescence, and the range of temperature over which it is observed, and the manner of its appearance and disappearance, are in agreement with the assumptions.

PARIS

Academy of Sciences, October 29.—M. H. Poincaré in the chair.—A new and rapid method for the determination of the errors of division of a meridian circle: M. **Loewy**. A more detailed discussion of a method described in outline in an earlier paper.—The moth of the beetroot, *Lita ocellatella*: Alfred **Giard**. The author has recognised by a further study of this parasite that he was in error in identifying it as belonging to the species *Loxostege sticticalis* of American naturalists, or *Phlyctaenodes* or *Eurycreon sticticalis*, according to the European nomenclature. The author points out the remarkable facility with which the larvæ escape through small apertures, and the danger through this cause of sending live specimens through a district not subject to this pest.—Observations on the sun made at the Observatory of Lyons during the third quarter of 1906: J. **Guillaume**. The results are summarised in three tables giving the surfaces of the sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The deformation of quadrics: Luigi **Bianchi**.—The transformations of some linear partial differential equations of the second order:

J **Clairin.**—The system of integrals of total differentials belonging to a hyperelliptic surface F **Traynard**—The complementary geodesic triangulations of the higher regions of the French Alps P **Helbronner**—The velocities of detonation of explosives M **Dautriche** The author describes a new method of measuring these velocities by the use of an explosive string The two ends of this are fired simultaneously by a detonator, and the point at which the two detonations meet determined by a special device After the accuracy of the method had been determined by blank experiments, in which both arms of the circuit consisted of the same material a tube containing another explosive was inserted in one of the arms It was found possible to measure the retardation to one hundred thousandth of a second—Stereoscopic relief by projection F **Estanave.**—The dissociation of matter under the influence of light and heat Gustave **Le Bon** Remarks on a recent paper by Sir W Ramsay and J Spencer—The migration of the phenyl group mode of fixation of hypoiodous acid and of the elimination of hydriodic acid M **Tiffeneau** In the fixation of HIO the hydroxyl group attaches itself by preference to the carbon atom to which the greatest number of groups are fixed and to that nearest the phenyl group In the elimination of HI the hydroxyl group nearest the phenyl group remains unattacked and there is a migration of the phenyl If on the contrary the hydroxyl group is removed from the phenyl group the elimination of HI tends to form ethylene oxides—Some new observations made at the summit of Mt Blanc on the effect of high altitudes on the blood corpuscles H **Guillemard** and R **Moog**—The coagulability of the subhepatic blood MM **Doyon,** Cl **Gautier,** and N **Kareff.** Contrary to the usually accepted views the authors from experiments on more than fifty dogs, conclude that the subhepatic blood does coagulate, and also contains fibrin—The lakes of the ring of Rabuons Maritime Alps André **Delebecque** An account of hydrographic researches done on these lakes during the summer of 1906

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 8

ROYAL SOCIETY, at 4 30—The Occurrence of Encystation in *Trypanosoma grayi* (Novy) with Remarks on Methods of Infection in Trypanosomes generally Prof E A Minchin—Note on the Continuous Rays observed in the Spark Spectra of Metalloids and some Metals Prof W N Hartley, F R S—The Composition of Thorianite, and the Relative Radio-activity of its Constituents Dr E H Büchner—A Numerical Examination of the Optical Properties of Thin Metallic Plates Prof R C Maclaurin—On a Compensated Micro-manometer B J P Roberts—Experimental Investigation as to the Dependence of Gravity on Temperature L Southerns

MATHEMATICAL SOCIETY at 5 30—Annual General Meeting—Presidential Address Partial Differential Equations some Criticisms and some Suggestions Prof A R Forsyth—Harmonic Expansions of Functions of Two Variables Prof A C Dixon—The General Solution of Laplace's Equation in n Dimensions G N Watson—On Sub-groups of a Finite Abelian Group H Hilton—On Bäcklund's Transformation and the Partial Differential Equation $s=F(r, y, z)$—On the Inversion of a Definite Integral H Bateman

INSTITUTION OF ELECTRICAL ENGINEERS at 8—Presentation of Premiums awarded for Papers Read or Published during 1905 06—Inaugural Address by the President Dr R T Glazebrook, F R S

FRIDAY, NOVEMBER 9

ROYAL ASTRONOMICAL SOCIETY, at 5—On the Effects of Radiation on the Motion of Comets (Second Note) H C Plummer—(1) On the Early Eclipses (2) The Early Eclipses of the Sun and Moon F Nevill—Note on a Mechanical Solution of Kepler's Equation H C Plummer—On the Possibility of Improving the Places of the Reference Stars for the Astrographic Catalogue from the Photographic Measures H H Turner—The Systematic Motions of the Stars A S Eddington—Stellar Parallax Papers, No 3, The Parallax of Eight Stars, from Photographs taken at the Cambridge Observatory H N Russell—Auroræ observed at Delting, Shetland 1905-6 Rev A C Henderson—*Probable Papers* Solar Parallax Papers, No. 5, Examination of the Photographic Places of Stars published in the Paris *Eros* Circular A R Hinks—Notes on Theoretical Spectroscopy E T Whittaker

PHYSICAL SOCIETY, at 8—Exhibition and Description of Experiments Suitable for Students in a Physics Laboratory G F C Searle

MALACOLOGICAL SOCIETY at 8—Description of a New Species of Calliostoma from S Formosa E A Smith, I S O—Description of a New Sub genus and Species of Alycæus from Ke'lan tan H B Preston—Description of Six New Species of Shells and of *Leptomya lintea*, Hutton from New Zealand H Suter—Descriptions of some Tertiary Shells from New Zealand H Suter

MONDAY, NOVEMBER 12

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—North Eastern Rhodesia J A Wallace

TUESDAY, NOVEMBER 13

INSTITUTION OF CIVIL ENGINEERS, at 8—Single-phase Electric Traction C F Jenkin

ZOOLOGICAL SOCIETY, at 8 30—On the Embryo of the Ok[illegible] Prof R Burckhardt—Zoological Results of the Third Tanganyika Expedition, conducted by Dr W A Cunnington, 1904-05 Report on the Turbellaria F F Laidlaw—List of Further Collections of Mammals from Western Australia, including a Series from Bernier Island, obtained for Mr W E Balston, with Field notes by the Collector, Mr G C Shortridge Oldfield Thomas, F R S—The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the Collections of Mr F W Townsend, 1893-1905, with Descriptions of New Species, Part ii, Pelecypoda J Cosmo Melvill and Robert Standen

MINERALOGICAL SOCIETY, at 8—Growth of Crystals of Soluble Salts on Each Other T V Barker—Notes on Some Bolivian Minerals L J Spencer—Note on Ilmenite from Brazil G F Herbert Smith—Description of the Lengenbach Quarry and of the Minerals found there in 1906 R H Solly—Note on the Thirty two Classes of Symmetry H Hilton—Note on a Canadian Mineral Prof Harrington

FARADAY SOCIETY at 8—Some Investigations Relative to the Depreciation of Electrolytically produced Solutions of Sodium Hypochlorite W Pollard Digby—The Hermite Electrolytic Process at Poplar C V Biggs—On the Electrochemistry of Lead Dr A. C C Cumming

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ROYAL SOCIETY, at 4 30—*Probable Papers* Calcium as an Absorbent of Gases, and its Applications in the Production of High Vacua and for Spectroscopic Research F Soddy—A Method of Gauging by Evaporation the Degree of High Vacua A J Berry—The Effect of Temperature on the Activity of Radium and its Transformation Products Dr H L Bronson—On the Refractive Indices of Gaseous Potassium, Zinc, Cadmium, Mercury Arsenic, Selenium and Tellurium C Cuthbertson and E P Metcalfe—The Photo electric Fatigue of Zinc H S Allen

CHEMICAL SOCIETY, at 8 30—On the Determination of the Rate of Chemical Change by Measurement of Gases Evolved F E E Lamplough—Xanthoxalanil and its Analogues S Ruhemann

LINNEAN SOCIETY, at 8—Recent Researches in Norway Horace W Monckton

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INSTITUTION OF MECHANICAL ENGINEERS at 8—Steam as a Motive Power for Public Service Vehicles T Clarkson

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A CORPUS OF AUSTRALIAN MYTHS.

Mythes et Légendes d'Australie, Études d'Ethnographie et de Sociologie By A van Gennep Pp cxvi + 188 (Paris E Guilmoto, 1906) Price 10 francs

WITH few exceptions the works on Australian aborigines are in English, the older ones are out of print, the newer ones exceedingly technical, demanding on the part of the reader some enthusiasm and a good deal of preliminary knowledge M van Gennep, therefore, has put before the French public a general survey of various controverted questions of Australian ethnography and sociology as a preface to the hundred and six myths and tales translated in the second portion of the volume before us

The eight chapters of the introduction deal with somatology and culture, kinship and descent, the methods by which social modifications are introduced, aboriginal ideas as to conception and reincarnation, exoteric and esoteric doctrines with regard to the bull-roarer, the idea of magico-religious power, the relations of myth and rite, and the content of the myths There are additional notes on the subject of Arunta primitiveness and on reincarnation and totemism

In the somatological section the author emphasises the local differences both as regards indices, pigmentation, and hair character, finally inclining to the views of Spencer and Gillen that a second race with three lines of migration has been superposed on an older stock akin to the Tasmanians M van Gennep then passes on to discuss the various attempts to identify the culture of Australia with that of Palæolithic Europe, and to distinguish various cultural cycles corresponding to ethnical differences, he comes to the conclusion that Schoetensack's theories are not proven, the coincidence of cultural elements being rather due to similarity of conditions The cultural areas of Frobenius and Graebner he dismisses as insufficiently evidenced, and vitiated by neglect of the influence of inter-tribal commerce

The chapter on filiation is complicated by controversies with M Durkheim on the one hand, Mr Andrew Lang on the other, the author holds that modification of the rules of descent is due to the change of view on physiological questions, where the child belongs to the kinship group of the mother, little or no part in producing conception is assigned by the tribe in question to the father, and *vice versâ* It seems a fatal objection to this view that whereas the Arunta are stated to have no idea of the importance of the male parent in this respect, they reckon descent of the intermarrying class through the father How could this come about? Does M van Gennep hold that they originally believed the child to be procreated by the father, and made the class rule fit in with this idea, that they subsequently modified their views on the mechanism of conception, and then adopted a new rule for the totem, retaining the old one for the class? This view seems to land us in considerable difficulties A criticism of the views of M Durkheim in this chapter contains an extraordinary misstatement, the Arunta have no rule that two persons of the same totem may not marry, just as they have no tabu of the totem animal, in reply to M Durkheim's statement of this fact, M van Gennep replies that the exogamic rule is strict among them A more unfortunate lapse it is impossible to imagine Apropos of the Arunta in particular, M van Gennep propounds a theory of the origin of classes in opposition to the commonly accepted dichotomous hypothesis, he holds that they originated " by convergence ", but unfortunately we do not learn what this means, save that it is in some way connected with the binary system of numeration which is almost universal in Australia

A long and important chapter deals with the ideas relative to sexual matters, but space is lacking for an analysis of this and of the chapter on the bull-roarer, the author suggests that the Australian deities associated with the latter are in reality thunder gods, a theory for which there is much to be said His suggestion on the other hand, that all other Australian divinities, so called, are either culture heroes or the body of deified ancestors, to use a somewhat inexact term, which among the Dieri are known as the *mura-mura*, is less acceptable, the only basis for this theory seems to be the fact that the *mura-mura* were originally spoken of by some incorrect writers as a god

On the subject of magico-religious power, or *mana*, M van Gennep holds that we must provisionally take the view that the Australians distinguish three kinds that of the *churinga* of the *arungquiltha*, and of the *atnongara* and it is to be hoped that workers in the field who commonly overlook the wide issues raised by their researches, will not fail to devote especial attention to this problem As a result of his discussion of myth and rite M van Gennep comes to the conclusion that the problem of anteriority is insoluble

The hundred and six myths which follow are carefully annotated and should give the reader a good idea of Australian myths and legendary tales As to the utility of M van Gennep's work there can be no doubt, but if he were writing for an English public the general impression would be that he had better have relegated controversy to a subordinate place and have aimed rather at expounding what is known than at putting together an introduction full of technical matter

N W T

THE LIFE AND WORK OF PLANTS

The Physiology of Plants, a Treatise upon the Metabolism and Sources of Energy in Plants By Dr W Pfeffer Second fully revised edition translated and edited by Dr Alfred J Ewart Vol iii Pp viii + 451 (Oxford The Clarendon Press 1906) Price 18s net

THAT Dr Pfeffer's great work has been issued in a worthy English translation is matter of congratulation to those to whom its treasures are thus rendered accessible, while welcomed by those familiar

with its value in its original form, who will find in it valuable additions, interpolated in brackets and in an appendix, which take account of the recent progress of the science

The newly issued third (and last) volume deals with the great subjects of movement, the production of heat, light and electricity, and the sources and transformations of energy in plants As in the former volumes, the width and accuracy of the author's acquaintance with the literature of the subjects under treatment are marvellous, and scarcely less so is the power of arrangement by which it is made available to others The book demands continuous and close attention from its readers, for it is crowded with information condensed so far as it can be without sacrificing clearness Dr Ewart deserves thanks for the excellence of the translation, a task the difficulties of which can be appreciated only by those that have attempted to translate a German scientific work into good English, and have experienced how hard it is to do so He deserves thanks also for wise reticence as regards the introduction of new technical terms, the employment of which is a very real obstacle to the progress of science unless they are required to ensure accuracy Most parts of botany have suffered more or less from this evil, and it is thus all the greater a pleasure to mark its absence from so fundamental a work as this

The treatment of each subject is exhaustive and of much interest While it demands the reader's undivided attention throughout, there is a noteworthy freedom from obscurity in the language, for which thanks are due to both the author and the translator

Under movement, the causes and mechanism are first discussed in preparation for the consideration of the varied kinds of movements in detail These are distinguished into movements of curvature, tropic movements, and locomotory and protoplasmic movements Under the first head are included autonomic movements, the movements of climbers and twiners, those due to mechanical and chemical stimuli, photonastic, thermonastic, and hydronastic curvatures, and the movements connected with dehiscence and dispersal Tropic movements are treated in a general way, and thereafter, under the various forms, the conditions for and the mechanism of each are dealt with The movements of protoplasm and its reactions to stimuli are placed under the third head, whether shown by locomotion of the entire cell or by movements of the protoplasm within the cell wall

The production of heat, light, and electricity by plants is thereafter discussed, and this is followed by a chapter on the sources and transformations of energy in plants, in which it is stated that, "apart from the locomotory movements which are absent from most plants, as many external manifestations of energy are shown in the vegetable kingdom as among animals" How widely different is such a view from that which regarded plants as little more than inert things, possessed of life and able to grow and to reproduce themselves, but far indeed beneath animals in their powers of response to external stimuli

A brief but very valuable appendix summarising the more important literature on the subject published since the completion of the German edition and an excellent index conclude the work

It will be seen from this brief abstract that this volume deals with subjects of extreme interest, in which great progress has been made towards a fuller understanding of plants as living organisms sensitive to influences from without, and adapting themselves to their environments The modern conception of the study of plants has become very much widened and deepened from that which prevailed when that study appeared to content itself with description and classification Yet there is a danger lest even advance may lead to narrowness of view through the impossibility of acquiring a personal knowledge of more than a limited part of the science of botany The disadvantages of too great specialisation are to be dreaded, and the benefits conferred by Dr Pfeffer's "Physiology of Plants" will be felt by systematists and morphologists not less than by physiologists From it they can gain a clear view of the plant as a living organism and can estimate the value of such knowledge in relation to their special fields of study Such a survey will probably bring to light new problems awaiting solution, and will leave the impression that though much has been accomplished deeper problems of life remain unsolved, and that the field of investigation only widens indefinitely To what has been gathered in its field no better guide can be obtained than that under review

STEAM AND HYDRAULIC TURBINES

(1) *Steam Turbines, with an Appendix on Gas Turbines, and the Future of Heat Engines* By Dr A Stodola Translated by Dr Louis C Loewenstein Second edition, enlarged and revised Pp xix+490 (New York D Van Nostrand Co, London Archibald Constable and Co, Ltd, 1906) Price 21s net

(2) *Steam Turbine Engineering* By T Stevens and H M Hobart Pp x+814 (London and New York Whittaker and Co, 1906) Price 21s net

(3) *Modern Turbine Practice and Water-power Plants* By John Wolf Thurso Pp xxii+244 (London Archibald Constable and Co, Ltd, 1906) Price 16s net

(4) *Hydraulic Motors with Related Subjects, including Centrifugal Pumps Pipes, and Open Channels* By Prof Irving P Church Pp ix+269 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1905)

(5) *Turbines* By W H Stuart Garnett Pp xiv+283 (London George Bell and Sons, 1906) Price 8s 6d net

(6) *Modern Steam Turbines* Edited by Arthur R Liddell Vol 1 The Schulz Steam Turbine By Max Dietrich Pp 73 (London A Owen and Co and T Fisher Unwin, 1906) Price 5s

(1) THIS is the second edition of Dr Loewenstein's authorised translation of the second edition of Dr Stodola's well-known treatise The first edition of the translation was recently fully reviewed

in these columns. The only change in the present edition is the incorporation of a supplement, prepared by the translator, giving the derivation, step by step, of the difficult formulæ in Dr Stodola's treatise, this supplement will be very acceptable to advanced students in our engineering schools It is a striking proof of the high estimation in which this text-book is held in the English speaking world that a second edition of the translation should so soon have been called for

(2) In their preface Messrs Stevens and Hobart point out that while a number of treatises on the steam turbine has been published, none of them so far has dealt with the subject from the point of view of the purchaser and user, though to them the question of economy, not only in steam consumption, but also in first cost and maintenance, is of the greatest importance In the second chapter the authors discuss the much vexed question of units, they abandon the well-known B Th U, and adopt for their unit, both for heat energy and mechanical energy, the kilowatt hour, or K W H, though expressing an abstract preference for the kilogram calorie as the unit of energy, similarly for the unit of power they have almost exclusively adopted the kilowatt (K W) in preference to the older unit, the horse-power (H P)

Since in dealing with the economy of steam turbines the authors have reduced all the results to kilograms of steam per kilowatt hour output from the dynamo driven by the turbine, it is inevitable that they should discard the older units We do not think, however, that the well-known B Th U will be displaced for many years to come, it is still the unit in which most English-speaking engineers think who have to deal with practical problems connected with the generation of steam, and it has certain practical advantages That some changes in our system of units will come in course of time we have no doubt, and we have equally no doubt that they will be to the advantage of British and American engineers, though we cannot agree with the somewhat far-fetched hypothesis of the authors that "the rapid rate at which Germany and Switzerland are coming to the front as rivals of English-speaking countries in manufacture and commerce" is due to our present system of units

To each of the types of turbines which have so far been successful on a commercial scale (De Laval, Parsons, Curtis, Rateau, &c), and to several others still more or less in an experimental stage, a separate chapter is devoted In each of these chapters the authors follow a definite procedure, they deal with the turbine, which is being considered, under two heads (not always in the same order) —(a) its economy as a machine for the conversion of heat energy into mechanical energy, (b) its design from the point of view of the user In the sections devoted to steam economy, the effect of varying the boiler, or admission, pressure, of varying the vacuum, and of superheating the steam is fully treated with the aid of most elaborate and carefully drawn up tables and curves are plotted from these tables, both at full and half loads, and the thermodynamic losses are analysed, in the portion of each chapter treating of design, the mechanical principles underlying the design of the turbine under discussion are explained with the aid of a number of reproductions of working drawings, unfortunately on such a small scale as often to render it impossible to make out clearly the details

An interesting point brought out by the elaborate analysis the authors have made of numerous published tests of De Laval and Parsons turbines is that while in the former a considerable reduction in the weight of steam per kilowatt hour is produced by increasing the boiler pressure there appears to be but little gain in this respect in the case of the latter when condensing, if the pressure is increased beyond 8 atmospheres, assuming, of course, that the same vacuum is maintained in each case It is only in the case of the De Laval and of the Parsons turbines that the results of sufficiently numerous tests have been published to enable the authors to discuss fully all the factors which make for economy in any given set of conditions, but they have in all cases given all the information which is so far available for each type of turbine

In connection with the Rateau turbine full details are given of the regenerative heat accumulators which have been erected at various works, where the steam working the turbines is the exhaust steam from previously existing reciprocating steam engines In chapter XIII are a series of steam tables, both in metric and in English units, from pressures of ½ lb to 200 lb per square inch, and two other useful tables, one the calorific values of fuel, the other losses in converting the energy of 1 lb of coal into electrical energy Two valuable chapters are XV and XVI, since in these first typical results are given as to steam economy in modern piston engines and then the authors enter into an elaborate analysis of the respective merits of the piston engine and the turbine from the point of view of working expenses They point out that forecasting the future is by no means an easy matter, it is certain, however, that the relative positions of these two types of engines as to economy in steam consumption will depend to a large extent upon the amount to which their special characteristics are developed and utilised, such as the fact that a high vacuum is more beneficial to the turbine than to the piston engine from the point of view of economy, while, as regards superheating, apparently the reverse holds

The next five chapters deal briefly with such problems as the foundations and engine buildings for turbines, and the cost and arrangement of separate condensing plants, all the data collected in regard to each point being grouped into a series of reference tables In chapter XXII, a very lengthy one the authors have brought together in the form of very carefully arranged tables all the published details of some twelve of the largest and most modern steam-turbine plants, and in addition there are some hundred illustrations, the many blank lines in these tables show how difficult it is to obtain information on points of great importance in connection with the planning of such plants

The final chapter is devoted to marine steam tur-

bines, and the authors have certainly succeeded in bringing together in a convenient form for reference a greater mass of information and data than has ever before been published in any one volume, they have almost attempted to be too up-to-date, as shown in the fact that the new giant Cunarder, recently launched on the Clyde, is called throughout *Susitania* instead of *Lusitania* A valuable bibliography and a complete index conclude a volume which must have involved immense labour in the compilation of the masses of figures with which its pages bristle, and in the preparation of the carefully drawn curves which pictorially represent so many of these elaborate tables, it will undoubtedly for many years be one of the standard works of reference on the steam turbine

(3) This work does not treat of the design of turbines, but gives such information in regard to modern water turbines and their installation as will be required by an engineer engaged in preparing plans for a proposed water-power plant In view of the fact that hitherto there have existed so far in hydraulic-power engineering no generally accepted terms, the author explains in an introduction all the terms he uses, gives a careful definition of each, and suggests that the nomenclature he has used might be generally adopted, it would certainly be a great boon to the student if the authors of text-books on turbines would conform to some definite and fixed nomenclature, both in dealing with the theory and also in explaining the mechanical construction of these machines

The first two chapters are devoted to an account of modern turbine practice in Europe and in America, and Mr Thurso is of opinion that not only have there been marked differences in the development of the turbine in the two continents, but that, on the whole, development has proceeded on more scientific lines in Europe, and much greater mechanical skill has been shown by the turbine builders of that continent in turning out highly-finished machines Up to a few years ago the axial-flow machine was the standard type of European builders, but the difficulty of regulating its speed, and the application of the turbine to the generation of electrical energy, which necessitated higher speeds and closer regulation, has led to the almost complete abandonment of this type, and to the adoption of some form of radial-flow turbine, the actual form adopted varying with the head of water available In America, the author points out, development has been on quite different lines, the modern turbine is a descendant of the radial inward-flow, or vortex, turbine of J B Francis, but, since the number of revolutions varies as the square root of the head of water, and since for the same head the revolutions of different machines will vary inversely as their diameter, the tendency has been, owing to the demand for high speed, to reduce the diameter, and thus to reduce the interior space available for the water to turn and escape axially when its work is done It has thus become necessary to turn the water in an axial direction while still in the runner-bucket, that is, to curve gradually the runner-bucket from a radial to an axial direction, giving these latter a very complicated form, and simultaneously with this there has been a tendency to increase the axial dimensions of the bucket entrances.

Up to a low head, say of 40 feet, the author is of opinion that the American turbine has great advantages over all others in common use, but for high heads he considers it is unsuitable, and that it cannot successfully compete with European types, he is also of opinion that the quality of workmanship and of materials used by American turbine builders is distinctly second-class, due no doubt to the existence of abundant water-power in all parts of the country, and to the belief of the average purchaser that water-power costs little or nothing, and that, therefore, any turbine which will run is good enough for his purpose He also considers that the practice of testing turbines in the flume at Holyoke, where the head is only 18 feet, has been prejudicial to development, since a good result on the test-bed by no means ensures a similar result when the machine is set up in the place where it is to work, often under heads far greater than those available at Holyoke

In chapter iii the various types of turbines are classified, and the general properties and characteristics of each class are briefly discussed, then follows the only chapter devoted to the steam turbine, and, in view of the small amount of space devoted to it, the inclusion of this chapter in the book has been clearly a mistake, it would have been much wiser if the author had omitted the steam turbine altogether, and had devoted the space thus set free to enlarging those portions of the book dealing with the accessories of turbines

The remainder of the book deals with modern types of water turbines, their construction, and the various accessories attached to them for the purpose of admitting and exhausting the water, governing their speed, &c and the decided opinion is expressed that, unless there is some definite reason to the contrary, horizontal shafts should always be adopted, a number of illustrations is given of large turbine plants recently erected in America and in Europe, and the essential points in the design of each are clearly set forth

The chapters on the accessories, &c, are especially valuable, as these details are often either neglected in text-books or treated in a very perfunctory fashion, the data given by the author will be found very valuable by all engineers engaged in planning water-power schemes, and they embody the results of wide experience of various classes of turbines, such important points as the difficulties induced by the formation of ice on a large scale and the means to be adopted to cope with them, and the measurement of water for selling power are fully dealt with

A paper by Mr A V Garratt on the elements of design favourable to speed regulation in plants driven by water-power is printed in the form of an appendix, the whole book is thoroughly up to date in its information, the facts and data are well marshalled, and it should be consulted by every engineer who may be called upon to deal with the problem of the utilisation of water-power.

(4) The great increase in the utilisation of water-power in all parts of the world, mainly in connection with the electric transmission of energy, has led to much more attention being devoted to this branch of engineering in all technical colleges, and this has naturally brought about a demand for text-books thoroughly up to date, and suited to modern developments of the industry. Prof. Church has attempted both to supply this need on the part of engineering students, and at the same time to write a book which will be of service to practising engineers; the subject has been treated by him, therefore, both from the theoretical and from the practical standpoint.

After dealing with the general considerations which govern the design of all types of hydraulic motors, one chapter is devoted to the various forms of gravity motors—overshot, breast, and undershot wheels—which have been so largely displaced in modern days by the turbine. Before dealing with turbine design the author shows that there are three theorems which lie at the basis of the theory of turbines and centrifugal pumps; these theorems are, in fact, fundamental principles of mechanics, though the third presupposes the existence of "steady flow"; this third theorem may be expressed as follows:—

"Power of a turbine in steady motion = angular velocity × change of angular momentum experienced by the mass of water flowing per unit of time in its passage through the turbine."

These theorems are illustrated by a series of numerical examples worked out in full.

In chapter iv. impulse wheels are considered, and the Pelton and the Girard impulse wheels are taken as illustrations of this type; in the next chapter the turbine proper or "reaction turbine," is taken up, and as a preliminary to the discussion of the modern turbine the theory of the Barker's mill is deduced; it is then shown that the Fourneyron turbine is a direct descendant of this old and simple form, and the theory of the Fourneyron form is then worked out both when friction is disregarded and when it is taken into account. Prof. Church then classifies turbines under four heads—(1) radial outward-flow, (2) radial inward-flow, (3) axial flow, (4) mixed flow—and deals with each of these classes in detail; he gives descriptions, with excellent illustrations, of well-known makes of each type, and concludes the chapter with the general theory of reaction turbines. The testing and regulating of turbines form the subject-matter of chapter vi., and a description is given of the Holyoke testing flume. The following chapter is devoted to the theory and construction of centrifugal pumps, and the formulæ deduced are illustrated by working out in full numerical examples.

The flow of water over weirs and through pipes and open channels is treated mainly from the point of view of the designer of turbine machinery, and in connection with this portion of the book there is a series of useful diagrams in the appendix for Kutter's coefficient, &c.

The book concludes with a chapter on pressure engines, hydraulic rams, and accumulators, the Worthington water-motor pump and the Brotherhood pressure engine being taken as examples. Prof. Church's book will undoubtedly be a recognised text-book for advanced engineering students.

(5) This book, originally intended to give a popular account of the history, construction, and operation both of water and steam turbines, has been extended in its scope, and the author has dealt with the important problem of blade design in such a way as to make it a text-book useful also to the technical student. After giving a brief history of the evolution of the water turbine, the conditions which must be fulfilled if such machines are to be efficient are fully discussed; then follow several chapters in which recent modern types of both impulse and reaction turbines are described with the help of a series of good illustrations; finally, this half of the book concludes with some details of the best methods of erecting water turbines and controlling them by governors.

In part ii. the steam turbine is taken up, and naturally attention is chiefly devoted to the Parsons, De Laval, and Curtis turbines; as these are practically the three types which have so far been commercially successful, a full description is given of the principles underlying the design and of the methods adopted in manufacturing the various parts of each of these well-known engines, and it is to be hoped that a study of this part of the book may do something to dissipate the extraordinary ignorance and misconception which prevail among men even of fair mechanical knowledge, in regard to the steam turbine and its possibilities. Special chapters are devoted to the application of the turbine to marine purposes, and a clear account is given of the rapid development in this field of work during the last few years both in the Royal Navy and in the merchant service. Turbo-blowers and rotary pumps are discussed in another chapter, and the advantages of these pumps over reciprocating pumps, where vast volumes of air have to be supplied as is the case in connection with the blast-furnace industry, are clearly set forth.

A series of appendices dealing briefly with the mathematical and mechanical principles involved in elementary engineering, with fluid motion, and with the behaviour of gas, conclude a book which will do much, it is probable, to make the layman take a more intelligent interest in this the latest and most striking development of the skill of the mechanical engineer.

(6) This is an authorised translation of a book by Herr Dietrich, in which he describes the various patents for steam turbines and their accessories taken out by Mr. R. Schulz, engine-works manager of the Germania Shipyard at Kiel, and also the results of tests of the Schulz turbine, both when used for marine work and for the generation of electrical energy.

The rest of the book is devoted to *ex parte* statements in reference to the controversy between Mr. Parsons and Mr. Schulz in regard to their respective inventions, which was eventually fought out in the Law Courts in an action brought for infringement of

patent rights It is not our province to enter into the details of this controversy, we need only say that Mr Schulz claims that he has succeeded better than any other inventor in solving the difficult problem of designing a practical and not too complicated turbine in which the steam consumption per horse-power hour is economical, not only at full power, but also when the engine is working at low loads, and he also claims that he has simplified the arrangements necessary on board ship, where go-astern machines must be provided as well as the go-ahead turbines The author gives a clear description of the mechanical details by which the inventor has secured the results he claims This book should be carefully studied by all those interested in the history of the development of the steam turbine T H B

OUR BOOK SHELF

Ueber chitinöse Fortbewegungs-Apparate einiger (insbesondere fussloser) Insektenlarven By Dr Wilhelm Leisewitz Pp iv+143, with 46 illustrations in the text (Munich C Reinhardt, 1906) Price 4 marks

THE author commenced his observations with the terminal appendage in the larva of *Xiphydria dromedarius* This larva which is almost apterous, lives in galleries in rotten wood, and the appendage is used firstly as a prop and partly to compress the loose substance behind it to give it a firm support as it gradually progresses by gnawing away the wood in front He then extended his researches to the hairs, bristles, &c, of other internal-feeding larvæ, especially those which are apterous or subapterous, and in this small volume we have the results of his careful investigations

The chitinous appendages used for locomotion by such larvæ consist chiefly of (1) undifferentiated hairs, (2) spines, (3) warts, and (4) bristles Where the larvæ live in hard substances, like wood or bark, the appendages consist of short, stiff hairs or spines and warts, but when the larvæ live in soft substances like rotten wood or mould they are provided with long, slender hairs or bristles of varying form

The greater portion of the essay is devoted to larvæ of Coleoptera, though a few others belonging to the orders Neuroptera, Lepidoptera, Diptera, and Hymenoptera are also noticed

Apart from the physiological interest of the inquiry, it is also of some importance to the systematist, for the author claims to have discovered trustworthy characters in the chitinous appendages, which will allow many species of Coleoptera, hitherto supposed to be indeterminable in the larval state, to be easily recognised W F KIRBY

Map of the British Isles Constructed by W and A K Johnston Size 72 inches x 63 inches Mounted on cloth with rollers and varnished (London W and A K Johnston, 1906) Price 21s

THE teaching of geography has received much attention in recent years, and the increased importance given to the subjects in schools has led to the production of several new series of excellent wall maps The present map is a new addition to one of these series It is boldly printed and coloured in a manner to make it easily visible in all parts of a large classroom The scale is 1 633,600, or ten miles to an inch The populations of the different towns are indicated by means of symbols, but it is to be feared that these will be of little use to anybody but the teacher The map will require to be supplemented by an orographical one if the physical geography of our country is to be studied satisfactorily

LETTER TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Production of Radium from Actinium

THE experimental evidence on the growth of radium from uranium has in the past been somewhat conflicting Both Mr Soddy and Mr Whetham have stated that they observed an increase with the time in the amount of radium in solutions of certain uranium salts which were under examination The writer, however, was able to show that, starting with a solution of uranium nitrate carefully purified by repeated crystallisation, the amount of radium formed in an interval of eighteen months was less than one two-thousandth of the amount which was to be expected from the disintegration theory

I think that this discrepancy is readily explained by the results of an experiment which I have just made on the growth of radium from actinium A kilogram of carnotite ore containing about 20 per cent of uranium was decomposed with an excess of dilute hydrochloric acid, and the solution thus obtained was treated with hydrogen sulphide, the precipitated sulphides being subsequently removed by filtration To the solution was then added a fraction of a gram of thorium nitrate followed by a solution of several grams of oxalic acid After standing for several days the slight precipitate which formed was completely removed and converted into a soluble nitrate The nitrate in dilute solution was again treated with an excess of oxalic acid, and this second precipitate was converted into a soluble chloride I have found from a considerable number of experiments that practically all the actinium contained in a uranium mineral can be separated in this manner

The solution of the chlorides containing the actinium was sealed up in a glass bulb, and about two months later, on April 25 last the gases and emanation were boiled out and collected After standing for some minutes the gas was introduced into an electroscope The activity of the emanation corresponded to a content of 5.7×10^{-9} gram of radium in the actinium solution The bulb was again sealed, and was allowed to remain undisturbed until to-day when the radium emanation present was again removed and tested The amount of radium emanation now found corresponds to 14.2×10^{-9} gram of radium, indicating that there has been formed in the solution during this interval of 195 days a quantity of radium equal to 8.5×10^{-9} gram This is equivalent to the production of about 1.6×10^{-8} gram of radium in one year and since the amount of radium in equilibrium with 200 grams of uranium is 7.6×10^{-5} gram, the value of $\lambda(\text{year})^{-1}$ for radium can be calculated, and is given as 2.2×10^{-4} The indicated half-value period would be about 3100 years This number can only be regarded as approximate at present, since the original content of uranium in the material used, and the completeness of the separation of the actinium, are both uncertain I think, however that another step has been made towards the solution of the somewhat complex problem of the genesis of radium, and, since the amount of actinium in a mineral is apparently always proportional to the amounts of uranium and radium present, that actinium will prove to be the looked-for intermediate product BERTRAM B BOLTWOOD

Sloane Laboratory of Yale College, New Haven, Conn November 5

A MODERN PHYSICAL LABORATORY

IN December of last year were opened at Gottingen a number of fine new buildings to accommodate the different subdivisions of the physical department of the University An account of these has just been published in a volume issued under the auspices of the Gottingen Association for the Promotion of Applied Physics and Mathematics[1] This book, a handsome quarto of 200 pages containing numerous illustrations and plans, gives a graphic idea of the elaboration which is now considered necessary for the successful carrying out of work in the different branches of this most rapidly developing science

FIG 1 —North Side of the Physical Institute University of Göttingen

Many physicists can remember the time when, even in the most progressive of our universities where large and well-fitted chemical laboratories had long been established the accommodation accorded to experimental physics consisted of two or three very ordinary rooms, with perhaps a stone pillar or two for galvanometers or cathetometer and a wide shelf outside the window for the Grove or Bunsen batteries By and by came a few accumulators, possibly home-made from jam-pots and roofing lead, the charging arrangements for these consisting of a dynamo of perhaps 25 per cent efficiency and a gas engine, the obstinacy of which in starting on a winter's morning still calls up recollections A pressure of 100 volts was to be treated with great respect, and no laboratory resistance-coil was made to carry more than a few amperes Nowadays it is impossible satisfactorily to house the various subdivisions of experimental physics in a single building, however palatial, and at Gottingen five separate and distinct "institutes" have been provided

1 "Die physikalischen Institute der Universität Göttingen Festschrift, 1906 Pp. iv+200. (Leipzig and Berlin B G Teubner 1906)

The speeches at the opening ceremony of the directors of each of these institutes sketch in an interesting and eloquent fashion the evolution of the whole from its small beginnings and review in succession the many honourable names which, from Gauss and Weber down to our own times, have been associated with the progress of physics at Gottingen Prof Riecke, speaking as head of the parent laboratory of pure physics, mentions how rapid was the increase, during the closing fifteen years of last century of work on the borderland between physics and chemistry, of the type in which Ostwald and Victor Meyer were pioneers This led to the foundation of a separate physical-chemical institute under the direction of Prof Nernst Again, the expansion of applied physics and of electrotechnics, particularly in its developments for lighting and power purposes, was so rapid that in 1898, with the aid of the Gottingen Association for the Promotion of Applied Physics and Mathematics an annexe to the main physics laboratory was erected This developed later with the help of substantial Government grants into the present institute for applied electricity, and when the new physical laboratory was erected the old building was constituted the institute for applied mathematics and mechanics

FIG 2 —Seismological Station, University of Gottingen

A similar evolution from earlier beginnings has been the history of the department for geophysics the child of the observatory for the study of terrestrial magnetism founded by Gauss In a historical *résumé* by Prof Wiechert is quoted a very interesting letter of Gauss to Olbers in 1833 in which he

describes his early experiments in telegraphy over a distance of a mile and a half. The equipment of the seismographic department of the geophysical institute is in every way unique and the new earthquake house built by Prof. Wiechert in 1902 is probably one of the finest in the world.

It is beyond the scope of this article to go into detail on each of these developments, but a study of the volume shows that the facilities provided for the student at Göttingen appear to be fairly comparable in a general way with those now available at Manchester, where the splendid new laboratories of Prof. Schuster at the University, and of the College of Technology in the city, provide together all that could be desired for a complete course of training and research in almost any branch of either the pure or applied science. Though there is much at each of the two universities which cannot be compared to any similar thing at the other, yet many details make the resemblance between the equipments for pure physics distinctly striking; for example, each possesses a large concave Rowland grating, with mounting specially designed for accurate photographic work, made by Krupp and by Sir Howard Grubb respectively. The magnificent equipment at Manchester has already rendered excellent service in the hands of Mr. Duffield in his investigation of the effect of pressure on arc spectra.

The volume under review is well got up and though considerable space is taken up with purely descriptive detail, there is much matter in it of real interest, for example many passages in the speeches delivered at the opening ceremony sparkle in a manner not usual in such efforts. We conclude with a translation of some extracts from the address of Prof. Voigt. He says:—

"What is it then which fetters the crystallographer so strongly to his science? I will try to explain it by a parable.

"Let us imagine in a large hall a couple of hundred brilliant violin-players who all play the same piece with instruments faultlessly tuned, but commence simultaneously at all sorts of different places and perhaps at the conclusion begin over again. The effect is (at least for Europeans) not exactly pleasant: a monotonous jumble of sounds, in which even the finest ear is unable to recognise what is being played.

"Such music the molecules of gaseous, liquid and *ordinary solid bodies make for us*. They may be highly gifted molecules with marvellous internal architecture, but in their activity each disturbs the others. A *crystal* on the contrary corresponds to the orchestra above described when the same is led by a vigorous conductor when all eyes intently watch his nod and all hands follow the exact beat. ... This picture renders it understandable how crystals can exhibit whole ranges of phenomena which are absolutely lacking in other bodies. ... In my opinion the music of physical law sounds forth in no other department in such full and rich accord as in crystal physics."

J. A. HARKER.

THE ETIOLOGY OF SLEEPING SICKNESS.[1]

AMONG the scientific achievements of the last decade few have been so remarkable as the rapid increase of knowledge with regard to the minute animalcules termed by zoologists Protozoa. More especially is this true as concerns the parasitic members of the group and their relation to disease in man and beast. It is now known that protozoan parasites are the cause of many diseases, especially in the tropics, and as a type of such we may refer to malaria, since the etiology of this disease is now so thoroughly known that it may serve as a model, as it were, of diseases due to Protozoa, and at the same time furnishes valuable analogies and suggests the problems to be investigated in other cases.

The classical researches of Laveran, Ross, and others have resulted in establishing clearly the cause and nature of malaria, and have proved definitely (1) that the illness is due to a minute protozoan parasite present in the blood and multiplying there, (2) that the disease is transmitted from sick to healthy persons by certain biting gnats or mosquitoes, a mosquito which has sucked blood from an infected person being capable, after a certain period of time, of inoculating other persons with the malarial parasite at subsequent feeds, and (3) that the parasite is not carried merely passively by the mosquito, but passes through an essential part of its life-cycle within it, since sexual forms of the parasite are developed which conjugate and multiply in the digestive tract of the mosquito in a manner different from the mode of multiplication in the blood of the patient. It is not extraordinary that diseases of this type should be especially prevalent in the tropics, where insect life is so richly developed, and the numerous blood-sucking insects of all kinds furnish the requisite means of transmitting and disseminating the parasitic micro-organisms.

Since Livingstone's time it has been known that horses and cattle in Africa die from a disease produced by the bites of the indigenous tsetse-flies. These flies, of which eight species are now known, belong to the genus Glossina, a genus of Diptera or two-winged flies characteristic of the African fauna and not found on other continents. The disease which they produce, termed nagana or tsetse-fly disease, is rapidly fatal to imported cattle or horses, but does not affect human beings. Various suppositions were put forward as to the nature of the malign power exerted by the dreaded tsetse-fly until the discoveries of Bruce solved the problem once and for all. Bruce found that the disease is caused by the presence in the blood of a minute flagellated organism belonging to the genus of parasitic Protozoa already known to zoologists by the name Trypanosoma, and that the parasite is transmitted from sick to healthy animals by the bite of the tsetse-fly, which was thus shown to play a part in the dissemination of nagana analogous to that played by the mosquito in the dissemination of malaria. Bruce's researches established for nagana the first two propositions stated above for malaria, but it remained to be proved whether the parasite did or did not undergo a definite developmental cycle in the tsetse-fly as the parasite of malaria does in the mosquito. Bruce discovered, however, another fact of great importance, namely, that the "trypanosomes" of nagana are to be found in the blood of indigenous wild game, such as antelopes and buffaloes, to which the parasites appear to be innocuous. These infected wild animals serve, however, as a reservoir for the disease, the trypanosomes being conveyed by the tsetse-fly from the indigenous wild animals to the susceptible domestic animals. No such natural "reservoir" has been proved as yet for the malarial parasite, though its existence has often been suspected.

It had long been known that negroes from the west coast of Africa were liable to a slow but fatal disease, which, from the peculiar comatose symptoms seen in the final stages, was termed the sleeping sickness. Nothing was known as to the nature of this

[1] "*Glossina palpalis* in its Relation to *Trypanosoma gambiense* and other Trypanosomes (Preliminary Report)." By E. A. Minchin, A. C. H. Gray and the late F. M. G. Tulloch. With 3 plates, 1 map and 11 text figures. (Proc. Roy. Soc., 1906.)

mysterious malady until quite recently, when it made its appearance in epidemic form in Uganda, producing an enormous mortality among the natives, and also attacking Europeans The outbreak of the disease was so serious and threatening that, at the request of the Government, the Royal Society sent out a commission to investigate the nature of the disease, and to discover, if possible, the means of checking the further spread of the epidemic The commission was not long in obtaining important results It was discovered that the cause of the disease was a trypanosome which in the early stages of the malady was present in the blood of the patient, but which later penetrated into the cerebro-spinal fluid, and then gave rise to the comatose symptoms characteristic of the disease It was further proved, once again by Bruce, that the parasite was transmitted from sick to healthy persons by the local species of tsetse-fly, *Glossina palpalis*, and that the sleeping sickness was, in fact, a human tsetse-fly disease comparable to the nagana of cattle, though caused by a different species of trypanosome transmitted by a different species of tsetse-fly and differing further from nagana in the nature of the symptoms produced It remained to investigate the exact relation of the parasite to the fly, that is to say, whether the trypanosome went through a developmental cycle in the tsetse-fly or not It may be added that in the case of sleeping

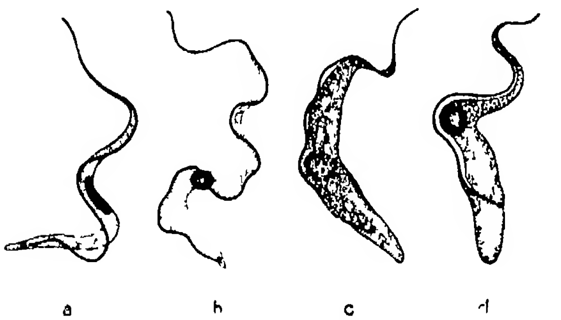

FIG 1 —*Trypanosoma gambiense* from the intestine of the tsetse fly twenty four hours after feeding upon an infected subject *a* and *b* male forms *c* and *d* female forms × 2000 diameters

sickness no natural "reservoir" has yet been discovered

Early in 1905 the present writer was sent out to Entebbe by the Royal Society in order to investigate the exact nature of the relationship between the trypanosome of sleeping sickness, *T gambiense* Dutton (= *T castellanii*, Kruse), and the tsetse-fly *Glossina palpalis* At the time of commencing this work the state of knowledge was as follows —The experiments of Bruce and Nabarro had proved that the tsetse-fly was capable of transmitting the parasitic micro-organism from an infected animal to one free from the infection if fed on the first, then on the second, with not more than forty-eight hours interval, and, further that tsetse-flies freshly caught in localities where sleeping sickness is rife such as Entebbe, were capable of infecting healthy animals Trypanosomes had also been observed to be present not infrequently in the digestive tract of freshly-caught flies, occurring in enormous numbers in certain regions of the intestine Special interest attached, naturally to these "wild" trypanosomes as they may be termed briefly, meaning thereby trypanosomes with which the fly had become infected in nature, and not as the result of being fed in the laboratory on infected animals Lieuts Gray and Tulloch, of the sleeping sickness commission, had made detailed observations on the wild trypanosomes, and had found them present in about 18 per cent of tsetse-flies caught at Entebbe The wild trypanosomes differed considerably in appearance and structure from those found in the blood or cerebro-spinal fluid of sleeping-sickness patients but not more than was capable of being explained as the result of developmental changes

At that time the late Dr Fritz Schaudinn had just published his well-known memoir on the life-cycle of the trypanosome of the little owl, *Athene noctua*, a work which created considerable stir among all workers upon Protozoa We were therefore, all fully prepared to discover complicated life-cycles involving great morphological changes in these organisms, and had little doubt but that observation would reveal a developmental cycle in the tsetse-fly analogous to that of the malarial parasite in the mosquito It was, moreover, reasonable to suppose that the trypanosomes found in tsetse-flies caught in Entebbe would be the trypanosomes of sleeping sickness, since, as already stated it had been proved experimentally that infection could be brought about by the bites of freshly caught flies When, therefore, we that is, the present writer working in collaboration with Messrs Gray and Tulloch—embarked upon these in-

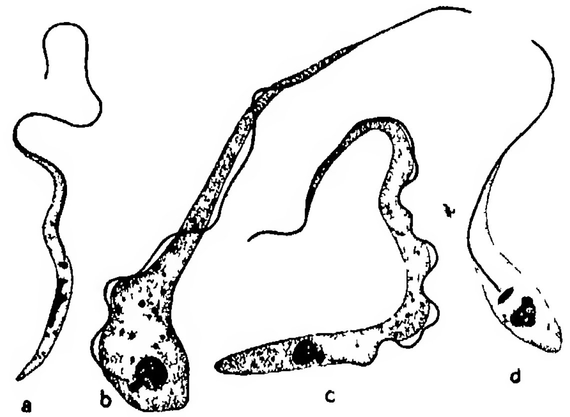

FIG 2 —*Trypanosoma grayi* from the intestine of the tsetse fly *a* male *b* female *c*, indifferent and *d* young forms × 2000 diameters

vestigations, we were fully convinced that the wild trypanosomes found in the tsetse-fly were nothing more than stages in the developmental cycle of *Trypanosoma gambiense*, and that it remained to work out this cycle in full detail and to refer the various forms of wild trypanosomes to their place in it

The methods by which this problem was attacked were partly experimental partly observational By both alike all attempts to establish a relationship between *Trypanosoma gambiense* of sleeping sickness and the wild trypanosomes occurring naturally in the tsetse-fly gave absolutely negative results and forced us gradually and reluctantly, but irresistibly, to the conclusion that the wild trypanosomes of the tsetse-fly have no connection whatever with sleeping sickness but belong to other species quite distinct from *T gambiense*, and innocuous to man

One series of experiments had for its object to determine the exact manner in which the tsetse-fly carries the trypanosome of sleeping sickness from an infected to a healthy animal If the parasite passed through a developmental cycle in the tsetse fly, it might be expected that the latter would show a certain periodicity in its infectiveness, that is to say that

after the fly had taken up the parasites, it would not be ripe, so to speak, to infect a healthy animal until after a certain period of time or a certain number of feeds, as is known to be the case with the mosquito in the transmission of malaria. To test this, and to discover the period necessary for the supposed cycle, batches of flies were fed first on an infected animal and then at regular intervals on a succession of healthy animals (monkeys), using a new healthy animal for each feed. In no case was an infection obtained later than forty-eight hours, although the experiments were extended over three weeks.

On the other hand, conclusive evidence was obtained of the existence of what may be termed direct mechanical infection, that is to say, if a tsetse be allowed to have a partial feed on an infected animal and be then transferred at once to a healthy animal, on which it is allowed to finish its feed, the second animal may become infected. This confirms the results previously obtained by Bruce, both for nagana and sleeping sickness. The experiment was varied by making the fly feed first on an infected animal and then on two healthy animals in rapid succession; it was then found that the first healthy animal became infected but not the second. If the tsetse dips its proboscis for an instant into the skin of a healthy animal, it appears to clean the proboscis and render the fly non-infectious to other animals. This indicates that the direct mechanical transmission is effected by the proboscis alone. As is well known, if a tsetse-fly be fed on an infected animal, then decapitated and its proboscis examined under the microscope, the cavity of the proboscis is seen to contain blood corpuscles and active trypanosomes, a fact which sufficiently explains the direct transmission. The experiments suggest that a tsetse which has fed on an infected subject is only infectious to the first healthy subject bitten by it afterwards.

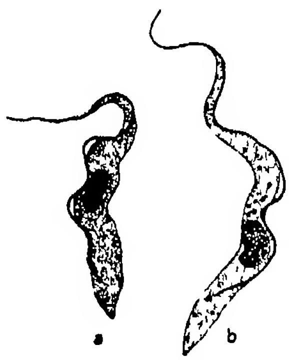

FIG. 3.—*Trypanosoma tullochii* from the intestine of the tsetse fly. × 2000 diameters.

A second series of experiments had for its object to test the connection, if any, between the wild trypanosomes and sleeping sickness. An island called Kimmi, not far from Entebbe in the Victoria Nyanza, was found to teem with tsetse-flies to a degree almost incredible to anyone who has not been there. Although this island was uninhabited and hardly ever visited by human beings, it was found that the tsetse-flies there were more often infected with trypanosomes than on the mainland, since on the average between 7 per cent. and 8 per cent. of Kimmi flies were found to harbour trypanosomes, as against 1.7 per cent. from the neighbourhood of Entebbe. The island of Nsadzi, adjacent to Kimmi, was found to be free from tsetse except in certain limited spots along the shore, and hence served as convenient ground for a camp and station for experimenting upon the flies of Kimmi. The method was to feed a batch of flies caught at Kimmi upon a given healthy experimental animal daily for a certain length of time, then, by dissection and microscopic examination of every fly in the batch, to find out how many of them contained trypanosomes. In this way it was possible to make certain that animals susceptible to sleeping sickness had been fed upon by one or more tsetse-flies containing trypanosomes. Had these wild trypanosomes been identical with those of sleeping sickness, it might have been expected that some at least of the experimental animals would have become infected, but not in a single case did this occur. Attempts to infect experimental animals by direct inoculation of trypanosomes from the intestine of the fly proved equally futile.

The microscopical observation of the trypanosomes within the tsetse-fly led to similar conclusions. If tsetse-flies were fed on animals infected with *Trypanosoma gambiense*, and subsequently dissected and examined after various intervals, it was found that the trypanosomes flourished and multiplied for the first twenty-four hours, becoming at the same time differentiated into two distinct types, the one slender, transparent, and active, the other bulky, granular, and sluggish in movement. Compared with what is known of developmental phases in other Protozoa, the slender forms may be called male (Fig. 1, *a*, *b*), the bulky forms female (Fig. 1, *c*, *d*). Up to forty-eight hours the multiplication continues, and a more "indifferent" type of individual appears. At seventy-two hours, however, the trypanosomes have become greatly diminished, and by ninety-six hours, or slightly later, the trypanosomes have disappeared completely from the gut of the tsetse-fly, this disappearance coinciding with the complete absorption of the blood with which they were taken in. *Trypanosoma gambiense* appears, in short, to have very limited powers of maintaining its existence in the gut of the tsetse, and to be unable to pass forwards into the blood ingested at feeds subsequent to that at which it was taken up by the fly.

In the case of the wild trypanosomes, on the other hand, a very different state of things is found to exist. A study of the forms found in different flies shows that two distinct types occur, one or the other usually being present, though exceptionally both may be found together in the same fly. One of these types, which Novy has named *Trypanosoma grayi*, is distinguished in all its phases by the relatively large size of the smaller mass of chromatin (micronucleus or blepharoplast), which is elongated in a direction transverse to the axis of the body, and placed almost invariably in front of the nucleus (Fig. 2, *a*–*d*). The other type, which we have named *T. tullochii*, is more like *T. gambiense* in its characters, having a small rounded blepharoplast placed well behind the nucleus (Fig. 3, *a*, *b*). Both these types are remarkable for their very great activity, whereby they swarm forwards in the gut of the fly into the blood ingested by it at each feed, and by their own exertions penetrate from the hindmost portion of the gut into its most anterior regions.

The conclusion drawn from these observations is that the "wild" trypanosomes, those found occurring naturally in the tsetse-fly at Entebbe, are not stages of the trypanosome of sleeping sickness, but represent at least two entirely distinct species. It remains to be discovered whence the tsetse-fly obtains these trypanosomes. It may be that the tsetse obtains them from the blood of indigenous animals upon which they are parasitic; *Trypanosoma grayi* has some resemblance to certain trypanosomes of birds, while *T. tullochii* is more of the type of a mammalian trypanosome. It may be, on the other hand, that they are parasites of the fly itself, and have no other host of any kind.

With regard to *Trypanosoma gambiense*, experiment and observation alike show that in Uganda it does not pass through a developmental cycle in the tsetse-fly, but is only transferred mechanically by the

fly's proboscis But the manner in which this trypanosome at first multiplies and develops into male and female forms in the fly's intestine is very remarkable, and suggests the commencement of a life-cycle which is not completed, but which might be so under other conditions In the case of the trypanosomes of fishes, Brumpt has shown that a given species will go through a complete development in a particular species of leech, but only through a part of the development in another species of leech There may be conditions, therefore, in which *T gambiense* would complete the developmental cycle which is seen to begin but appears to be inhibited, in the tsetse-fly in Uganda It must be borne in mind that the sleeping sickness is a new thing, apparently, on the Victoria Nyanza, and has broken out there comparatively recently in epidemic form

In conclusion, there remains only the sad duty of referring to the untimely death of the youngest of the three collaborators in this work, who became himself in some way infected with the trypanosomes which he was studying, and passed away before the results of the investigation were published Only those who knew Forbes Tulloch can gauge the loss and bereavement occasioned by his tragic end

ὁ Δαφνις ἔβα ῥόον ἔκλυσε δίνα
Τὸν Μώσαις φίλον ἄνδρα

E A MINCHIN

THE WIRELESS TELEGRAPHY CONFERENCE

THE second International Conference on Wireless Telegraphy, which has been sitting during the past few weeks at Berlin, concluded its labours on Saturday, November 3, when the first "Convention radiotélégraphique internationale" was signed by all the representatives of the Powers The States which have signed the convention are the following — Great Britain, Germany, the United States of America Argentina, Austria-Hungary, Belgium Brazil, Bulgaria, Chili, Denmark, Spain, France Greece Italy, Japan, Mexico Monaco, Norway, the Netherlands, Persia, Portugal, Rumania Russia, Sweden Turkey and Uruguay

The first conference, which it will be remembered was only of a preliminary nature was held in Berlin in August, 1903, and a summary of the results then attained was given in NATURE at the time (NATURE vol lxviii p 437) It was there pointed out that by far the most important resolution which the conference had to consider was that making it compulsory on all coastal stations to receive from and transmit to ships at sea all messages irrespective of system and the hope was expressed that private interests would not be allowed to stand in the way of the development of one of the most beneficial of the recent practical applications of science Three years have passed since that conference was held, but the correspondence and articles which have lately been so prominent in the daily Press show that this period has served neither to allay private jealousies nor to enlighten public opinion on the true merits of the case, the same appeals to ignorance and prejudice have been made now by both parties to the dispute as were made then

As the whole question of the justice or injustice of the provisions of the present conference turns on the claims of Signor Marconi, it will not, perhaps, be out of place to recapitulate very briefly the early history of wireless telegraphy In using the expression "wireless telegraphy," we use it in the sense now almost universally accepted of telegraphy by Hertzian waves, as any consideration of earth conduction or magnetic induction methods has naturally nothing to do with the present conference The foundations of wireless telegraphy were laid, as everyone knows, by Clerk Maxwell in the theory which gave rise to the experimental researches of Hertz At the Bath meeting of the British Association in 1888, when the results of Hertz's work were brought to the notice of British men of science by Prof Fitzgerald some experiments by Sir Oliver Lodge on the same subject were also described which showed that he was within an ace of making the same discoveries himself For some time after this experimental work was chiefly devoted to the confirmation and extension of the work of Hertz It was early recognised that there were possibilities about the new discovery which might render it a useful means of telegraphic communication, and suggestions to this effect appeared in 1891 in *The Electrician*, and in 1892 in the *Fortnightly Review* (from the pen of Sir William Crookes)

The practical application of Hertz waves to telegraphic purposes needed, however, the invention of a delicate detecting mechanism What Lord Kelvin did for submarine telegraphy by the invention of the syphon recorder, Lodge and Branly did for wireless telegraphy by the invention of the coherer (1889–1891) From this time onward progress was rapid In 1894 Sir Oliver Lodge demonstrated at the Royal Institution the transmission of signals over considerable distances and through several obstacles But the credit for first establishing the practical utility of the system for demonstrating that it was not merely a new scientific toy lies with Signor Marconi, and to his energy and perseverance we owe it that wireless telegraphy is an art was born in 1896 To his energy, also, and to that of those associated with him, we undoubtedly owe, not only the most extended system of wireless telegraphy of to-day, but also to a large extent the extension of other systems which but for his lead would never have reached their present development Yet no student of scientific progress can doubt for a moment that if Marconi had not stepped in at the critical point some other would have taken his place The work of the true pioneers was done the way into the new country was discovered and it remained only for the most energetic and resourceful to till the virgin soil and reap the plentiful harvest

Now that the reaping of the harvest is in sight we are confronted with the rival claims of the sowers With a wisdom characteristic of the times the Powers have decided that though each may sow and reap for himself he shall conduct his operations in the way most advantageous to civilisation This decision is embodied in the third article of the convention which provides that "coastal stations and stations on shipboard are bound to interchange telegrams without distinction of the system of wireless telegraphy adopted by them" On behalf of the Marconi Company it has been urged that this provision was devised with the express purpose of obtaining for all systems—and especially the Telefunken system—the immense advantages of the Marconi Company's extended organisation On the other hand, there could be no other reason for objecting to this clause than a desire on the part of the objector to establish a monopoly As was pointed out in the article in NATURE to which reference has already been made, the peculiarities of wireless telegraphy render it essential for public utility that there should be either a world monopoly or a perfectly free interchange between competing systems It is not difficult to choose between these alternatives and no one, we venture to think ten years hence will question the correctness of the decision now made

There is little doubt, also, that once it is reconciled to the inevitable, the Marconi Company will realise the very substantial benefits it will obtain, both financially and otherwise. It is clear that the free and rapid growth of any one system will now tend to the development of all; it is clear, too, that the advantageous positions obtained by the Marconi Company on the coasts of the greatest shipping nation of the world will confer on it an inestimable advantage, of which it would surely have been deprived had a monopoly been allowed. It has been several times pointed out in NATURE that State control—and international control—of wireless telegraphy is a necessity, a fact recognised by all nations, and that this control could not be the control of a privately owned monopoly.

In reference to this clause—the only one of first importance—it should be mentioned that certain Powers, amongst them Great Britain, reserve the right to exempt certain stations from its operation on condition that they provide adequate substitutes for the closed stations.

One other proposal of great importance was that brought forward by the United States, that there should be the same obligation for compulsory intercommunication between ship and ship, and a supplementary agreement to this effect was signed by all the Powers except Great Britain, Japan, Italy, Mexico, and Persia. In view of the onerous nature of this obligation on shipowners in the present state of the art, we are inclined to think that the time is not yet ripe for its adoption, though doubtless it will be adopted by all the Powers at some future conference, and in the meantime individual ships have everything to gain and nothing to lose by carrying out its object whenever possible.

The convention also provides for priority of all messages of distress and answers thereto, for equitable division and regulation of charges, and for the establishment of an international bureau for the transaction of administrative work, publication of information, and so forth, but none of the twenty-three other articles deserves special comment. It may be added, though this naturally goes almost without saying, that the convention imposes no restrictions on the naval or military uses of wireless telegraphy. These never were and never could be a subject for international settlement. The various States are pledged to ratify the provisions as quickly as possible, and it is hoped the convention will become operative on July 1, 1908. Between now and then we shall probably hear and read a good deal more about it in Parliament and in the Press, and it is to be hoped that those who write on the subject to the daily Press will make some attempt to understand the technicalities and to study the provisions of the convention.

MAURICE SOLOMON.

NOTES.

THE honours conferred by the King on the occasion of his sixty-fifth birthday appear to be mainly for political services, and there is little recognition of the claims of science. Mr. John Tweedy, president of the Royal College of Physicians, has received the honour of knighthood; Colonel R. C. Hellard, director-general of the Ordnance Survey, and Mr. F. G. Ogilvie, principal assistant secretary (Technology and Higher Education in Science and Art) Board of Education, have been appointed Companions of the Order of the Bath; Colonel D. A. Johnston, formerly director-general of the Ordnance Survey, has been appointed a Knight Commander of the Order of Saint Michael and Saint George; Prof. R. W. Boyce, F.R.S., has received the honour of knighthood, and Dr. J. M. Lang, Vice-Chancellor and principal of the University of Aberdeen, has been appointed a Commander of the Royal Victorian Order.

A STATEMENT has recently obtained currency that the French people themselves, after a hundred years' use of the metric system, cannot claim that it has been adopted throughout France, and a free translation of a circular issued to chambers of commerce in France by the French Minister of Commerce has been employed to support the statement. The Decimal Association in this country recently addressed a letter to the French Minister of Commerce with a view to determine what justification existed for the statement referred to. The Minister's reply makes it clear that the circular is directed only against the use of *old names* in certain trades, and that the English translation misinterprets its meaning and conveys a wholly wrong impression. It is satisfactory to find, in view of such endeavours to retard the acceptance of the metric system by this country, that it has recently been adopted in the works of Messrs. Joseph Crosfield and Sons, Ltd., and steadily grows in popularity.

UNDER the chairmanship of Mr. Lawrence Hardy, M.P., a large and representative conference of fruit growers from the fruit-growing counties of England was held at the South-Eastern Agricultural College, Wye, on November 7. Papers were contributed on planting of fruit trees, strawberries, American blight, and fungus diseases. In the latter paper reference was made to the American gooseberry mildew, the appearance of which in England has been noted by the college mycologist (Mr. Salmon), and a resolution calling upon the Board of Agriculture to take immediate steps to prevent further importation of gooseberry bushes and to destroy infected stocks in this country was unanimously passed. The disease appeared in Ireland in 1900, and has made most extensive ravages in that country, and serious alarm is felt by growers that a similar result may ensue in England unless drastic measures are immediately taken.

SHOCKS of earthquake were felt at Akureiri, Iceland, at 10.20 p.m. on November 8, followed by more shocks of less violence between 1 a.m. and 2 a.m. on November 9.

PROF. W. WIEN, professor of physics in the University of Würzburg, has become chief editor of the *Annalen der Physik* (Leipzig: J. A. Barth) in succession to the late Prof. Drude.

THE Bradshaw lecture of the Royal College of Surgeons will be delivered by Mr. Edmund Owen on Wednesday, December 12, upon the subject of "Cancer: its Treatment by Modern Methods."

A CHRISTMAS course of lectures, adapted to a juvenile auditory, will be delivered at the Royal Institution by Mr. W. Duddell on "Signalling to a Distance, from Primitive Man to Radiotelegraphy" (experimentally illustrated). The lectures will commence on December 27.

IT is proposed, on the occasion of the retirement of Major Craigie, C.B., from the Board of Agriculture and Fisheries, to entertain him at a complimentary dinner on Wednesday, December 12, in recognition of his services to the interests of agriculture and the furtherance of statistical knowledge.

THE balloon *Milano*, of 1000 cubic metres capacity, which started from the exhibition grounds at Milan on Sunday morning, November 11, descended at Aix-les-Bains at

2 p m on the same day, having crossed Mont Blanc The *Milano*, which was piloted by Signori Murillo and Cresti rose to an altitude of upwards of 6000 metres while crossing the Alps

THE Board of Agriculture and Fisheries announces that a horticultural exhibition will be held at Mannheim, in the Grand Duchy of Baden, from May to October, 1907 Exhibits from this country will be admitted to the fruit, vegetable, orchid, and cactus shows Applications for information should be addressed to the office of the exhibition, Friedrichsplatz 14, Mannheim, Germany

AT the annual general meeting of the Mathematical Society on November 8 the council and officers for the ensuing session were elected The list is as follows — *president*, Prof W Burnside, *vice presidents*, Sir Wm Niven, Prof A R Forsyth, *treasurer*, Prof J Larmor, *secretaries*, Prof A E H Love, Mr J H Grace, *other members of the council*, Dr H F Baker, Mr A Berry Mr A I Dixon Prof E B Elliott, Dr J W L Glaisher, Mr G H Hardy Dr E W Hobson Prof H M Macdonald Mr A F Western, Mr A Young

THE *Athenaeum* announces the death in his sixty sixth year of Prof A K Christomanos professor of general chemistry in the University of Athens In 1889 Prof Christomanos became director of the chemical laboratory in the University, and by his efforts it was brought to a high standard of perfection He was the author of a number of works dealing with his special subjects, and also did good work in geology and mineralogy

THE Prince of Monaco is *La Nature* reports arranging for a first international conference on oceanography and marine meteorology to be held if possible, at the time of the inauguration of the museum of oceanography The latter date is not yet fixed, but foreign men of science are being invited to take part in the proposed conference Inquiries and other communications should be addressed to Dr Jules Richard at Monaco

MR JOHN DEVONSHIRE ELLIS who died at his residence at Worksop on Sunday, November 11 was one of the makers of modern Sheffield, and a pioneer in the development of British metallurgy He was the first to adopt the Bessemer process of steel making and introduced many important inventions in the manufacture of armour plates He was vice-president of the Iron and Steel Institute, and in 1889 received from that body the Bessemer gold medal in recognition of the value of his services to the metallurgy of iron

CIRCULARS of invitation have just been issued to the ninth International Congress of Geography to be held at Geneva on July 27 August 6 1908 The president of the congress will be Dr A de Claparède president of the Geographical Society of Geneva vice-presidents Profs R Gautier and R Chodat, and general secretary, M Fernand Tavel Most of the sections of the congress will meet in rooms at the University of Geneva Four languages—German, French, Italian, and English—will be recognised at the congress and memoirs should be written in one of these languages or in Latin Papers and abstracts should be sent in by November 30, 1907

AT the annual general meeting of the Cambridge Philosophical Society on October 29, Dr Fenton, vice president in the chair, the following were elected officers of the society for the ensuing session —*president*, Dr Hobson, *vice-presidents*, Dr Baker, Dr Fenton, Mr D Sharp *treasurer*, Mr H F Newall, *secretaries*, Mr A E Shipley, Rev F W Barnes, Mr P V Bevan, *new members of the council* Prof Larmor, Prof Thomson, Dr Duckworth, Mr W G Fearnsides

A REUTER message from Paris states that M Santos Dumont made further trials of his airship on Monday in the presence of members of the committee of the Aéro Club and numerous spectators At the second trial two wheels of the apparatus left the ground and in five and one-fifth seconds the machine travelled a distance of about 500 metres in the course of which it rose four times At another trial the aeroplane started off followed by a motor car conveying the members of the committee It rapidly covered 500 metres, proceeding by successive bounds and soon outpacing the motor car The committee, on measuring afterwards the distances traversed, found that the aeroplane after reaching a height of between four and five metres, had traversed in level flight a distance of 220 metres without touching the ground in twenty-one and one fifth seconds thus travelling at the rate of about ten metres a second The best time recorded was seven and one fifth seconds over a distance of 82 60 metres representing a speed of about 40 kilometres an hour

MALARIA in Greece was the subject of a paper read by Major Ronald Ross F R S before the Oxford Medical Society on November 9 Prof Ross described the valley of Lake Kopais in Bœotia the scene of his recent study of malaria in Greece The locality was the dried-up bed of a large lake drained in remote times but in the Middle Ages reverting to marsh once more owing to the drainage works falling out of repair Recently restoration has been taken in hand and the bed of the ancient lake is now a fertile plain covered with crops of all kinds but the inhabitants are decimated by malaria the type of disease being very severe pernicious attacks common and black water fever extremely common In five localities the minimum malaria-rate among children was found to range between 25 5 per cent and 40 9 per cent Prof Ross considers that the country is eminently suited to the application of drainage measures for the eradication of the disease A Grecian malaria society has commenced the work with energy and an appeal for funds on behalf of the scheme has been issued by the Liverpool School of Tropical Medicine and is under the patronage of Princess Christian

THE *Daily Chronicle's* correspondent at Rome reports that Prof Waldstein's international project for the excavation of Herculaneum has gained the unanimous adhesion of the Royal Commission of Antiquities and Fine Arts in Rome under the following conditions among others — (1) Subscriptions are to be of a private character without the official intervention of foreign States and the funds are to be administered by an International Committee centred in Rome (2) An executive commission is to be constituted of foreign members representing the contributing countries and Italian representatives (3) All scientific material to be published first of all under the supervision and at the expense of the Italian Government the Minister of Public Instruction being empowered to invite the co operation of national and foreign publishing houses (4) All objects excavated to be the absolute property of the Italian Government, which however will retain the faculty of conceding to foreign States according to the measure of their respective generosity as contributors to the exploration fund, duplicates and other finds where this can be done without prejudice to Italy's national collections

AT the inaugural meeting of the new session of the Institution of Civil Engineers on November 6, the president, Sir Alexander Kennedy, F R S , delivered an address on the relation of the engineer and engineering to the world at large In relation to science, he pointed out that not a few engineers spend their whole lives in what is really scientific work, while nominally only earning their daily bread in ordinary mechanical pursuits The paths of the artist and the engineer seem too often to be divergent, but as soon as engineering works are treated on their own merits, and not as if they are mistaken imitations of other things, it will be found that they can possess even artistic as well as other merits Everyone now recognises that there is a dignity in a *Dreadnought* which is almost majestic, and that a modern liner forms really as fine a subject for a picture as a full-rigged ship In concluding, the president spoke of the future of engineering and of the possibility—which he thought a very small one—of finding anything in mechanical science corresponding to the "survival of the fittest," or any traceable lines along which mechanical evolution takes place Invention forms such a disturbing influence in engineering evolution that any prophecy on evolutionary lines is impossible It is still more useless to attempt to forestall the future by trying to do to-day what it is supposed that other people may try to do twenty years hence The *Great Eastern*, broken up for scrap almost within hail of the *Carmania* was a pathetic tragedy, from this point of view in engineering

EDUCATIONAL Leaflet No 22 of the National Association of Audubon Societies is devoted to an account of the blue jay (*Cyanocitta cristata*) by Mr W Dutcher, the president of the association It is accompanied by a coloured plate of the bird

THE greater part of the September issue of the Proceedings of the Philadelphia Academy is taken up by the description of a large collection of Orthoptera from Montana Utah, Colorado and the Yellowstone Park The authors of the paper are Messrs J A G Rehn and M Hebard of whom the second made the collection Many new forms are described

OF two zoological articles included in Nos 6 and 7 of the fifth volume of the *Boletin de la Sociedad Aragonesa de Ciencias Naturales*, the first, by the Rev R P Longinos Navas, is devoted to abnormal hens' eggs of which several are figured in a coloured plate Some of these appear to be of the type not uncommonly met with in the case of old birds about to cease from laying One however, is remarkable for its rose-red colour, due it is supposed to the parent hen having fed on a particular kind of bulb In the second three new Spanish Neuroptera are described one forming the type of a new genus

IN an address delivered to the Hull Scientific and Field Naturalists' Club at a conversazione held on October 17 Mr T Sheppard the president took for his subject the relationship between provincial museums and local scientific societies The address has been published in the Transactions of the club, and reprinted in pamphlet form as No 36 of the Hull Museum Publications Hull, it appears is very fortunate in respect to the good relations existing between the municipal museum and the local scientific society this good fellowship it is stated, being of special value to the museum and likewise, in a minor degree, conducive to the interests of the ratepayers In many other towns the relationship is, however, according to Mr Sheppard, of a less satisfactory nature, the museum officials ignoring the work and disdaining the assistance of the amateurs Neither is it considered advantageous for the museum to be "run" by the local society, such an arrangement tending, it is urged, to check donations owing to want of security as to the permanency of the former

ACCORDING to *La Nature* of November 3, Brussels is about to inaugurate a new era in the matter of fresh-water aquariums by the opening of a building in the Avenue Louise The new institution is not intended to be a merely popular exhibit, with a few tanks in which a certain number of more or less unhealthy-looking fishes are shown On the contrary, it is purposed to display, as time goes on, the complete fresh-water fauna of Belgium in suitably constructed basins and tanks, including, of course, those distinctive of rivers, lakes, and ponds Nor will the flora be neglected, the scheme being to show as much of this as is found practicable The central salon will resemble a winter garden, with a large central basin and tanks let into the walls In some of these tanks will be shown examples of all the indigenous fresh water fishes while others will be devoted to the exhibition of crustaceans molluscs, batrachians, reptiles, worms, insects, and plankton It is hoped that the institution will prove, not only an attraction to the general public, but that it will have a definite scientific value, and will also aid in the re-stocking of the depleted Belgian rivers with fish Acclimatisation is to be a feature of the aquarium, in which a tank will be reserved for the American cat-fish, preparatory to introducing that species into the rivers of the country

THE history and origin of zoological gardens and natural history museums forms the subject of a long article by Mr J von Pleyel in *Naturwissenschaftliche Wochenschrift* for October 28 Menageries, in the author's opinion, owe their origin partly to the cult of sacred animals and partly to the ambition of rulers to possess specimens of rare and valuable creatures from foreign lands or savage ones from their own In their simplest form zoological gardens were indeed, one of the earliest developments of culture and were familiar to the Chinese, Indians, Greeks Romans and pre-Spanish Mexicans in very ancient times The oldest recorded menagerie is as might be expected Chinese dating from 1150 B C The den of lions kept by Darius as described in the Book of Daniel, is an example of one of these primitive menageries, while the cult of sacred white horses by the ancient Greeks and Romans, and that of so called white elephants in Burma and Siam, are instances of a second type After a survey of the records of establishments of this nature during the Middle Ages and immediately succeeding periods, the author refers to the typical menageries of modern times, incidentally mentioning that a live giraffe was received at Schönbrunn so early as 1828 The Paris establishment is regarded as the earliest entitled to the designation "zoological gardens," in the modern sense of that term which owes its origin, however, to the foundation of the menagerie in the Regent's Park Of German establishments of this nature, the one at Berlin is the earliest

THE causes producing a cessation of vitality in old trees are imperfectly, if at all, understood There are various interesting problems concerned with this question, notably the continued propagation of trees by vegetative methods In this connection Mr R S Hole is contributing an article on pollard-shoots, stool-shoots, and root-suckers to the *Indian Forester* (July and August) It seems probable

that root-suckers play an important part in the regeneration of some Indian trees, and the author instances the production of practically pure woods of *Diospyros tomentosa* and *Ougenia dalbergioides* by this means, so that the subject is worthy of careful inquiry and observation

THE September number of the Quarterly Journal issued from the Liverpool University Institute of Commercial Research in the Tropics deals mainly with agriculture on the west coast of Africa Viscount Mountmorres writes a eulogistic article on the results achieved by the Gold Coast Department of Agriculture, comparing the gardens at Aburi very favourably with the gardens at Konakry, in French Guinea Rubber and cacao are the primary products at Aburi, and the instruction of the natives in their cultivation and preparation is an important branch of the work An account of the agricultural resources of the Ivory Coast, contributed by Mr E Castaing, provides interesting information as to the commercial varieties of the indigenous rubbers, the nature and uses of kola nuts, and the native method of preparing palm-oil

AN account of the red-rot disease of sugar-cane caused by the fungus *Colletotrichum falcatum* occupies a considerable portion of the third memoir of the Department of Agriculture in India which deals with fungus diseases of sugar-cane The author, Dr E J Butler, adduces evidence to show that the disease generally originates in the lower part of the plant, producing eventually characteristic red streaks in the vascular tissues Amongst other fungal pests, Dr Butler describes two stem diseases attributed to new species of Cytospora and Sphæronema and a more serious leaf spot disease caused by a species of Cercospora also differing from species hitherto recorded

THE Department of Commerce and Labour Washington, has issued a report on the blind and deaf (including the deaf and dumb) in the United States the data having been collected in connection with the twelfth census (1900) At the census itself, however, the work of the enumerators was restricted to a brief preliminary return showing the name, sex, age, post-office address, and nature of the existing defects in all persons alleged to be blind or deaf More detailed information was then obtained by direct correspondence with the individuals named in the primary returns, or with their parents or guardians, questions being asked as to the total or partial character of the defect, the age at which the defect, if not congenital, was first remarked, the supposed cause, the relationship if any, between the parents, the relatives who were similarly defective, and the school, if any, at which the defective person had attended It is from the data contained in these personal returns that the report is compiled Dr Alexander Graham Bell is responsible for the scope and conduct of the investigation, and the text of the report relating to the deaf It may be noted that of the blind whose parents were cousins 25 per cent were congenitally blind, whilst of the blind whose parents were not so related only 7 per cent were congenitally blind Similarly, of the deaf whose parents were cousins 42 per cent were congenitally deaf, whilst of the deaf whose parents were not so related only 15 per cent were congenitally deaf The report is a valuable one, with much more, and more trustworthy, information than has yet been obtained in any similar investigation but it suffers from a common defect, viz the lack of comparative information of a similar kind relating to the non-defective, which is essential to a proper interpretation of the results, this especially applies to the statistics relating to defective relatives and to the consanguinity of the parents The need is only partially met by the comparative figures for congenital and non-congenital defectives

A NOTE by Signor Alessandro Artom on his system of wireless telegraphy, first invented in 1903, is contributed to the *Atti* of the Lincei Academy xv (1), 12 The peculiarity of this system is that by the use of two aerial conductors instead of a single antenna an unsymmetric electromagnetic field is produced, and it is thus possible to send messages in definite directions Experiments have been made with the cooperation of the Italian naval authorities, chiefly between Monte Mario (Rome) Anzio (distant 55 km), and the island of Maddalena By varying the orientation of the aerials, communication could be established or cut off at will

THE new "Dolomiten Strasse" brings many of the most interesting portions of the Dolomite region within easy access Leaving Cortina, it rises rapidly over the Col di Falzarego, passing over a shoulder of Monte Nuvolau and affording a fine distant view of the Marmolata ice fields It then descends rapidly to Pieve Livinallonga where it skirts the hill-side at a considerable height above the valley, and it next rises by zigzags to the top of the Pordoi Pass, passing close by some of the most interesting members of the Sella group From here it descends to Campitello, whence Botzen may be reached *viâ* the Karersee The new road is completed with the exception of the portion from the Col di Falzerego to Cortina, where the old road is available for vehicular traffic

A "NATURE-KNOWLEDGE DIARY," compiled by Mr W Percival Westell, has been published by Messrs Blackie and Son Ltd Provision is made for plotting the daily barometer readings on a suitably numbered squared paper chart, but it does not seem to have occurred to the compiler that thermometer readings are also worth plotting, and that the same charts can be used for this purpose The general arrangement of the blank forms for recording observations of which the diary is almost entirely made up is likely to prove convenient The price of the book is 6*d* net

THE eighth edition of Prof R Hertwig's "Lehrbuch der Zoologie" has just been published by Mr Gustav Fischer Jena The work originally appeared fifteen years ago and was reviewed in NATURE of June 22 1893 (vol xlviii p 173)

OUR ASTRONOMICAL COLUMN

DISCOVERY OF A NEW COMET —A telegram from the Kiel Centralstelle announces the discovery of a new comet at Copenhagen on November 10 Its position at 17h 35m (Copenhagen M T) was

$$\text{R A} = 9\text{h}\ 16\text{m}\ 32\text{s},\ \text{dec} = 12^\circ\ 28'\ 31''\ \text{N}$$

and it is travelling in a north-easterly direction The daily movement is given as +4 2m in R A and +1° 10′ in declination When discovered, the comet was about 8m west of ε Leonis, and is therefore travelling towards the constellation Leo Its position rises, at present at about 11 p m

A second telegram from the Centralstelle informs us that this object was observed by Herr Rheden at Vienna on November 11 its position at 16h 75m (Vienna M T) being

$$\text{R A} = 9\text{h}\ 20\text{m}\ 9\text{s}\quad \text{dec} = +13^\circ\ 35'\ 25''$$

Unfortunately no idea of the comet's brightness is given in these telegrams

THE TELLURIC LINES IN THE SOLAR SPECTRUM —M Štefánik is proceeding with his researches on the direct observation of the infra-red portion of the spectrum, and publishes an account of his most recent results in a communication to the Paris Academy of Sciences (*Comptes rendus*, No 17) After briefly reciting the history of our knowledge of the telluric bands and lines, the author describes the two spectroscopes with which he carried out his researches at Chamonix, at the Grands-Mulets, and on the summit of Mont Blanc In each case he employed the red screens which he has previously described, and by this means was able to see the region of the spectrum which extends from about B to 1 μ On July 21, at the Grands-Mulets, he observed the setting sun with his prism spectroscope and found that as the sun sank lower the group *a* was unequally strengthened in parts, whilst several feeble bands became visible between *a* and A The groups *Z*, X, *and* Π *were successively reinforced, notably more so as the* sun sank into the haze gathered at the horizon Similar observations made with the grating spectroscope at the summit of Mont Blanc on July 30 gave similar results and a feeble band appeared between the groups A and *Z* The *increase in intensity of the groups Z and* π was so considerable that their telluric origin was very obvious Zenith observations revealed changes which in general were of the opposite character At all three stations M Štefánik obtained a number of photographs when the sun was *highest and at the horizon respectively*, with both spectroscopes

THE NUMBER OF THE VISIBLE STARS —The total number of stars usually supposed to be visible in the largest telescopes and on the best photographs is about one hundred million, but according to a computation recently made by Mr Gore this number must be accepted as the outside maximum To obtain his results Mr Gore made a number of counts on the photographic prints given in the late Dr Roberts's volume of stellar photographs, and found that the average number of stars per square degree was 4137 in the Milky Way 1782 near the Milky Way and 406 in the non-galactic regions Combining these results with the estimated areas of galactic and non galactic regions published by Prof E C Pickering, he obtained as the grand total of visible stars the number 64 184 757 This is probably smaller than the actual total, as some of the fainter star images would probably be lost in the reproduction of Dr Roberts's photographs

Clusters and nebulæ were avoided in making the counts, so that Mr Gore's total will have to be increased on this account In another count the average richness of the irregular clusters came out as 5752 stars per square degree but this is far below the average richness of the globular clusters, one of which ω Centauri shows 25 000 stars per square degree (*Observatory*, No 376)

STARS WITH PECULIAR SPECTRA —In No 4129 of the *Astronomische Nachrichten* Dr H Ludendorff discusses the spectra of the stars R Coronæ Borealis 12 Canum Venaticorum and 72 Ophiuchi which he and Dr Eberhard have photographed with the three-prism spectroscope (No iv) of the Potsdam Observatory The remarkable feature in the spectrum of R Coronæ is the non-appearance of the hydrogen lines $H\beta$, $H\gamma$ and $H\delta$ as the H and K lines are broad the absence of $H\epsilon$ cannot be affirmed but on a smaller scale spectrogram the ultra-violet lines of hydrogen do not appear From the measurement of about thirty or forty lines on each of five spectrograms, Dr Ludendorff finds the radial velocity of this star to be about +24 6 km as compared with Prof Frost's value of +14 km The present values were however obtained during a period when the star was at its normal brightness whereas Prof Frost's referred to a period when it was fainter It thus appears that the radial velocity may vary during the epochs of magnitude changes

In the spectrum of 12 Canum Venaticorum, Dr Ludendorff suspects changes in various chromium and iron lines The magnesium line λ 4481 also appears to vary and, whilst he can find no reason for the variation Dr Ludendorff suggests that this may be analogous to a similar phenomenon which Sir Norman Lockyer has pointed out in the spectrum of α Andromedæ both stars being of the Markabian type

AN INTERESTING VARIABLE STAR —In No 4126 of the *Astronomische Nachrichten* Prof Barnard publishes the results of his visual observation of a variable situated in the brightest part of the cluster M3 (N G C 5272)

Observations were made on 112 nights since March, 1899, and from the results the period was found to be 15 77594 days The maximum magnitude of this object is about 12 0, and it varies through about two magnitudes

CATALOGUE OF DOUBLE STARS —Prof Doberck continues the results of his double-star observations at the Hong Kong Observatory in Nos 4130–1 of the *Astronomische Nachrichten* The present list is similar in form to those previously published, and contains the results for about 170 stars

THE TENTH INTERNATIONAL GEOLOGICAL CONGRESS

THE tenth International Geological Congress met this year in Mexico, and the proceedings connected with it extended altogether over a period of nearly two months Elaborate arrangements for the reception and entertainment of the members were made by the Mexican authorities, the President of the Republic, General Porfirio Diaz, himself manifested a lively interest in the work of the congress and desired that everything possible should be done to make it successful Over and above this, liberal financial assistance was rendered, the Mexican Government bearing half the cost of the steamer and railway fares of those attending the meeting

In all more than six hundred membership tickets were issued, members resident in Mexico of course predominated, and second place was taken by those from the remainder of the North American continent, of European countries, Germany was most strongly represented which was perhaps natural in view of the large number of Germans who are engaged on the Mexican Geological Survey It was surprising to find so few British representatives present considering the great attractions which the country offers both to the geologist and to the mineralogist, all told there were not more than five members who could reasonably be said to be representative of British science, and not one of these was officially delegated to the congress This apparent indifference did not pass without comment on the part of the Mexican officials

Several fairly long excursions, which will be referred to later, were arranged to take place before the meetings, but the formal proceedings of the congress began with the meeting of the council on the morning of Thursday September 6 when the general arrangements were finally settled and a programme of papers &c , was drawn up for approval at the opening session, this took place the same forenoon in the hall of the old Minería (now part of the National School of Engineering) This meeting was presided over by President Diaz who also at the conclusion of the business, formally declared the congress open In addition to the speeches of welcome and addresses by the retiring president and the president-elect the only business consisted in the approval of the proposed programme and of the proposed executive committee The principal offices in the executive were filled by the election of the corresponding officers of the provisional committee in Mexico, as follows —*president*, José G Aguilera, director of the National Geological Institute (the Geological Survey), *general secretary* Ezequiel Ordoñez and *treasurer*, Juan D Villarello both of whom are also on the Survey

The first of the ordinary meetings (which were held in the newly-completed National Geological Institute) took place on the afternoon of Thursday, September 6, under the presidency of Prof Credner (Leipzig) A letter was first read from Mr Karpinski (St Petersburg) accompanying a copy of his memoir on "Les Trochilisques"—doubtful fossils occurring only in the Devonian—after which Mr G H Heilprin read a communication on "The Occurrence and Interrelation of Volcanic and Seismic Phenomena," in which he maintained the view that shocks of tectonic origin are scarcely to be dis-

tinguished from those of volcanic origin, seismic phenomena are often preceded and accompanied by magnetic disturbances This view was combated, however, by Prof Lawson and Dr Becker, while Mr H F Reid held that the available data are quite insufficient for deciding the point Dr K Renz (Breslau) next read a paper, "Ueber das ältere Mesozoicum Griechenlands," adducing reasons why certain marbles hitherto referred to the Cretaceous might be transferred to the Trias

Several papers the titles of which appeared on the programme were abandoned or postponed owing to the absence of their authors

It had been arranged that the meetings of the congress should take place only on alternate days, the intervening days being devoted to sight-seeing and excursions, so the second meeting did not take place until the forenoon of Saturday, September 8, when Prof Diener (Vienna) occupied the chair The first business was a statement by Dr Adams (Montreal) regarding the general geological map of North America, of which copies (each consisting of four large sheets, scale 1 5,000 000) had been previously distributed to the members This map has been prepared in accordance with the instructions of the Geological Society of America, which at its last meeting in Ottawa, appointed a committee (members —J C Russell (president) J G Aguilera, Bailey Willis F Adams C W Hayes) to carry the matter through The expense was borne by the Geological Survey of the United States, the Mexican Government assisting by purchasing a large number of copies for presentation to the members of the present congress Explanatory notices are provided by Messrs Bailey Willis and Aguilera The nomenclature adopted is that of the United States Survey and at the meeting this called forth a certain amount of criticism from Prof Lawson (California) especially with reference to the use of the term "Algonkian"

The remainder of the forenoon meeting and the greater part of the afternoon meeting were devoted to papers and discussion on "The Climatic Conditions during the Geological Epochs" The first contribution was made by Prof J W E David (Sydney) who discussed the glacial phenomena more especially of Australia but also of India South Africa and South America He was followed by Prof Frech (Breslau), "Ueber die Klimaänderungen der geologischen Vergangenheit" From Palæozoic times up to the present there has always been a correlation between the climatic evolution of the earth and the proportion of carbonic anhydride and of water vapour present in the atmosphere Increases are due to volcanic exhalations and diminutions to the formation of organic and more especially of inorganic compounds

At the afternoon meeting of September 8 presided over by Prof Frech the general discussion was opened by Dr E Philippi (Berlin) and was continued by Messrs C Burckhardt (Mexico) Frech A Rothpletz (Munich) C Diener F v Kerner (Vienna) Vorwerg (Herischdorf) A P Coleman (Toronto) and M Allorge (Oxford), it is impossible however, to give in the space now available even a short review of the discussion The general results were summed up by the chairman who considered that the following might apparently be accepted as well-ascertained facts —the existence of a Permo-Carboniferous Glacial epoch uniformity of climate during the Triassic and the Jurassic the existence of zones of climate since the Middle Cretaceous and a gradual diminution of temperature during the Ternary and the Quaternary

This was followed by a paper by General J de Lamothe (Grenoble) on "Le Climat de l'Afrique du Nord pendant les Periodes Pleiocène et Pleistocène" after which Prof Stefanescu (Bucharest) gave a description of the skeleton of *Dinotherium gigantissimum* (Stefanescu) a new species discovered by him in 1888, and, finally a study by Mr Hilgard on "The Causes of the Glacial Epoch" was contributed by Mr M Manson

The discussion on climatic conditions was reopened at the next meeting on Monday September 10, when Dr Becker presided The point chiefly dealt with was the question as to the causes which led to extensive glaciation in parts of the earth's surface where under present conditions, an extensive snowfall is difficult to explain The principal speakers were Messrs W M Davis (Harvard) H L Fairchild (Rochester), Heilprin (Washington) David and Frech

The remainder of the forenoon meeting on September 10 and part of the afternoon meeting (under the presidency of Prof Tschernyscheff, St Petersburg), were devoted to the subject of the formation of ore deposits, but many of the papers announced in the programme were abandoned The first paper was by Mr H F Bain (Illinois), on "Some Relations of Palæography to Ore Deposition in the Mississippi Valley," and led to some discussion as to the possibility of soluble salts of the heavy metals reach ing the sea there to be deposited by secondary action In his communication "Sur la Relation entre l'État propylitique (Grunstein) des Andesites et la Genèse des Filons liés à cette Roche," Mr B v Inkey (Domotori) showed that the formation of the Grunstein which is so characteristic for the metalliferous veins of Hungary (and also as Prof Kemp pointed out for those of the Sierra Nevada) is due chiefly to the chloritisation of the black augite and hornblende of the original andesite, and results from an action quite different from the kaolinisation along the veins themselves This paper also gave rise to considerable discussion Prof J F Kemp (New York) read a paper on "Ore Deposits at the Contacts of Intrusive Rocks and Limestones and their Significance as regards the General Formation of Veins" holding that the evidence indicated that part of the material for the mineral formation must have been brought in by water which probably came from the intrusive magma Other papers, which however did not give rise to much discussion were contributed by Mr Villarello (Mexico) "Sur le Remplissage de quelques Gîtes metallifères" Mr W H Weed (Washington) "The Origin and Classification of Ore Deposits" and Mr Lindgren "The Relation of Ore Deposits to Depth"

Three papers illustrated by lantern pictures followed the first by Mr G Andersen dealing with the Swedish Antarctic Expedition was contributed by Prof Sjogren the second, by Mr Heilprin dealt with the eruption at Martinique whilst the third by Dr Tempest Anderson (York) dealt with that of St Vincent

At the Wednesday's meeting September 12 presided over by Prof Rothpletz Prof Konigsberger (Freiburg i B) read a paper "Ueber den Verlauf der Geoisothermen in Bergen, und seine Beeinflussung durch Schichtstellung Wasserläufe und chemische Processe" In the course of this he showed how by means of a special apparatus devised by him variations of underground temperature might be measured accurately and indications obtained by which volcanic eruptions might be foretold This led to a discussion in which Messrs Becker Schmidt (Stuttgart), Günther (Munich) and von Kerner (Vienna) took part Thereafter Prof Keilhack (Berlin) discussed the mode of formation of the onyx bed at Etla Oaxaca (Mexico) and Mr Diaz (Colima) gave particulars regarding the volcano of Colima pointing out that there was apparently a periodicity in its activity It was announced that the discussions on "The Nomenclature and Classification of Rocks" and on "The Relations between 'Tectonique' and Eruptive Masses" would not be proceeded with

Various resolutions of the council were approved namely that the new subject for the Spendiaroff prize be "The Description of a Fauna with Reference to its Geological Evolution and its Geographical Distribution" re-approval of the proposal to create a model institute of geophysics the institution of a special commission to study the variations of the geothermal degree

The concluding items were a lecture by Mr Sabatini (Rome) on "La dernière Éruption du Vésuve" and another by Dr Tempest Anderson on the same subject these were accompanied by lantern illustrations

There was no afternoon session

The last meetings took place on Friday September 14 At the forenoon session Mr C W Hayes (Washington) presiding the most important matter dealt with was "The Earthquake of San Francisco" introduced by Prof Lawson whose paper was followed by a discussion in which Messrs Frech T L Ransome (Washington) and H F Reid (Baltimore) took part The other papers were on "Interglacial Periods in Canada" by Prof Coleman "Geologic Classification in the North-Central

Portion of the United States," by H N Darton (Washington)", "A Meteorite Crater of Arizona" by Prof Fairchild

The afternoon meeting was presided over by the president, Mr Aguilera Only two papers were communicated, one at the beginning by Prof David, on "The Occurrence of Diamond in Matrix at Oakey Creek, Inverell New South Wales," and one at the end by Mr E O Hovey (New York) on "La Sierra Madre Occidentale de l'Etat de Chihuahua," which was illustrated with lantern views The intervening period was taken up with reports and general business Prof Reid gave a *resumé* of the report of the International Glacier Committee, of which he is president No report having been received (though asked for) from the committee on the geological map of Europe a motion was carried regretting the omission The secretary read a report by Sir Archibald Geikie, president of the committee on cooperation in geological investigation, which was approved It was announced that the committee of the Spendiaroff prize had awarded this to Prof Tschernyschéff for his work on "Die obercarbonischen Brachiopoden des Ural und des Timan" Prof Frech presented the report of the committee on the "Palæontologica Universalis" and its proposal to extend the scope of its publications was unanimously approved, several new American and Mexican members were elected to the committee

Prof Sjogren then invited the congress to hold its eleventh session at Stockholm, and in 1910 instead of 1909 The invitation was accepted with acclamation and it was agreed to leave the date to be fixed by the Swedish committee (In view of the British Association meeting at Winnipeg in 1909, the later date would be preferable so far as British geologists are concerned)

Hearty votes of thanks to the Mexican Government and the organising committee were passed on the motion of Prof Stefanescu and Mr Sabatini They were responded to by Mr Aguilera who thanked the foreign geologists for coming so far to make the congress a success and invited them all to meet again at Stockholm This closed the formal business of the congress

A number of very interesting excursions had been arranged in connection with the congress They were of two kinds—one-day excursions between the meetings, and long excursions of from three to twenty days' duration which took place before and after the congress proper The former were free of expense to the members and for the others an inclusive charge which averaged about fifteen shillings *per diem* was made the greater part of the expense being borne by the Mexican Government

The first one-day excursion was devoted to the City of Mexico itself the members being driven about the town and shown the museums and other public institutions On the Sunday a long day was devoted to Cuernavaca and this proved to be probably the most interesting of all After journeying for some miles over the plain in which Mexico stands at an altitude of nearly 7500 feet, there is a stiff ascent of the range which bounds this plain, the railway reaching an altitude of almost 10,000 feet Cuernavaca lies nearly 5000 feet down on the other side and the steep, winding descent is very picturesque From near the summit magnificent views are obtained over the lower plain from which rise numerous volcanic cones and ranges apparently but little changed from the time of their formation, the whole stretches out before the observer just like an immense relief map On the map, the distance from Mexico to Cuernavaca is barely forty miles, by rail it is seventy-five and the double journey takes more than nine hours The town itself has one of the finest situations in Mexico and is a favourite resort Cortes built his country palace there and on its terrace the congress was entertained to a banquet by the Municipal Council

Another day was spent in visiting the Toltec remains at San Juan Teotihuacan Here there are two pyramids (of the sun and the moon) and the remains of many other interesting structures After inspecting these, the members lunched in the "Grotto Porfirio Diaz" a large natural cavity formed under an ancient lava flow in the neighbourhood

The last of these excursions was to the celebrated silver district of Pachuca, where visits were paid to various mines and works, in these the celebrated "patio process" was seen in operation on a large scale

Four of the long excursions took place before the congress opened One, of nine days' duration, was to the south, and visited, in addition to various districts of more purely geological interest, the famous Mitla ruins near Oaxaca Another, of three days, went east to Vera Cruz, on the coast, returning by Orizaba over the celebrated picturesque route of the Mexican Railway (known as "The Queen's Own" from its British origin), with its difficult engineering and striking scenery The remaining excursions had special attraction for vulcanologists On the one, the principal points of interest were Jorulla and Toluca, though the whole excursion lasted for thirteen days, while the last, of twelve days' duration, had Colima as its principal attraction

In connection with these excursions, the greatest pains had been taken to make the visits as enjoyable and profitable as possible Special trains, conveyances, and riding horses were provided detachments of the famous *Rurales* (a kind of military gendarmerie) attended to the safety and comfort of the travellers, where hotels were not available on the cross-country journeys, camp equipment was sent in advance or the proprietors of *haciendas* were called upon for hospitality The travellers, therefore, performed their journeyings under exceptionally favourable conditions It was not possible to carry out the full programme in every case, however, as the excursions took place during the rainy season, which this year has been somewhat exceptional At the same time, the difficulties or dangers were not nearly so great as, it appears, the sensational accounts in some European papers would lead one to believe was the case

The principal excursion took place after the congress from September 15 to October 4 The field covered extended from Mexico City right up to Arizona in the north and down to Tampico in the east and the distance travelled amounted to three or four thousand miles The members taking part were accommodated in two special Pullman trains which served both as means of conveyance and as hotel The route was arranged so as to include a very wide range of interesting ground, so that all tastes were catered for Numerous mines were visited—sulphur silver copper, lead, and coal—also oil wells various smelting and separation processes were seen in operation extinct craters were inspected and fossiliferous beds were searched for specimens and, in addition, there was the general interest peculiar to the country itself to say nothing of the splendid hospitality everywhere encountered It is impossible to enter into details of the trip but two striking features may be mentioned The first is the great stretch of semi-arid region towards the north of the Republic through which the railway passes for hundreds of miles This is practically level, and consists of a series of "Bolsons," which at first sight look as if they must have been of lacustrine formation The evidence is entirely against this however and the supposition is that though the first depositions may have taken place in shallow lakes these were soon obliterated and the great bulk of the deposit was levelled out simply by the rush of surface water during the rainy seasons From the plains thus formed the mountains rise with startling abruptness as from a sea, sometimes with fantastic outlines, so that the traveller could almost imagine he was sailing some distance off a mountainous coast like that of Norway Even more interesting were the opportunities afforded for studying geological structure on a large scale The mountain ranges are generally bare of vegetation and overlying material, so that the contortion folding and faulting of strata formation of anticlinal valleys &c can be observed with the greatest ease This was particularly noticeable along the railways in the neighbourhood of Monterrey and it was a matter for regret that arrangements had not been made for the train to stop at various points to enable the photographers of the party to make proper exposures, good photographs of many of the structures observed would have possessed all the lucidity of geological diagrams with the additional advantages which pertain to truthful representations of actual structures

A special side excursion had been arranged for those members of the party specially interested in mining and metallurgy. These, as the guests of the Copper Queen Co., left the main body at El Paso, on the frontier, and travelled west to Bisbee (Arizona), Cananea (Sonora, Mexico), Douglas (Arizona) and Nacozari (Sonora), visiting the various copper mines and smelting works at these places, and then rejoining the main party.

Although by that time the rainy season was supposed to be nearly over, the members taking part in the northern excursion also had some experience of the difficulties caused by "wash-outs," &c., in a country like Mexico, and at several places the programme had to be curtailed owing to delays to the trains.

The last event of all was an excursion of a week's duration made by a party of sixty or seventy members, who left Mexico City on October 6 to visit the Isthmus of Tehuantepec as the guests of Sir Weetman Pearson, whose firm have constructed the railway and docks which now serve as a means of communication between the Atlantic and Pacific coasts of the Republic at its narrowest part.

As has been indicated, the members of the congress were everywhere received with the greatest hospitality on the excursions as well as in the capital. One of the many social functions during the meeting may perhaps be allowed special mention; this was the reception of the members by President and Madame Diaz in the famous Palace of Chapultepec ("The Hill of the Grasshopper"). After having been welcomed by their hosts, they spent some time admiring the magnificent views from the upper terraces, including the city and the distant snow-capped peaks of Popocatapetl and Ixtaccihuatl. In the evening they were entertained to a banquet on the lower terrace; they had been invited "to tea," but tea appeared to be the one thing which was not provided.

The meeting of the congress was in all respects a very great success, and for this the Mexican officials, both of the Government and of the congress, deserve the highest praise. While all did well, it is no disparagement to the others to say that thanks are specially due to the general secretary, Mr. Ordoñez, for the admirable manner in which he filled that responsible and trying position.

METEOROLOGICAL NOTES

THE frequency of thunderstorms in relation to the sun-spot period is discussed by Dr. Aksel S. Steen in a reprint from the "Hann Band der meteorologischen Zeitschrift." The author has dealt with data from Norway, Sweden and Denmark, using material from twenty, twenty-eight and eight stations in each country respectively, extending from the years 1873 to 1903. The result of the inquiry is to show that the curves for the frequency at each of these regions have maxima at about the times of the sun-spot maxima and minima at about sun-spot minima, but underlying this variation one of half the period is apparent. In combining the results of all the three stations, the curve still shows the eleven-year variation with the change of shorter duration.

Dr. Steen suggests that similar observations covering other regions should be discussed to see if they exhibit similar changes.

Another reprint from the same "Hann Band" deals with the yearly air movement as determined by registering anemometers over some European stations, and is contributed by Dr. Felix M. Exner. The author discusses in the first instance wind observations made at Pola, Vienna, Potsdam, Zurich, Säntis, Bremen, Obir and Sonnblick.

His method of analysis is to calculate the resultant of the sixteen wind directions and to reduce them to north and west components. Thus winds from the west or east were considered as +W and −W, while those from the north or south were treated as +N and −N. The resulting west and north components were then determined for each year and expressed in units of hundreds of kilometres.

It is shown that according to the sign of the west component, with the exception of Pola, all the stations are under the influence of the general air circulation from the west. In the case of the north component, such a general result is not obtained. It is positive in Vienna, Zurich and on the Sonnblick, sometimes positive in Pola and on the Obir, but generally negative. Local causes are suggested as to the origin of some of these results. At Potsdam, Bremen and Säntis the north component is negative, and these are considered as good undisturbed stations.

The proportion of the north to the west component is generally less than 1 or 1 . . . so that the resulting wind direction is from the S.S.W. The author next investigates the atmospheric pressure values in relation to these variations of wind direction and velocity, and concludes that the yearly northern pressure gradients vary considerably, and that these changes harmonise in a satisfactory manner with those of the air movements. The paper is accompanied by numerous sets of curves showing the similarity of the variations discussed.

Prof. H. Hildebrand Hildebrandsson contributes an important article in the same "Hann Band" on the circulation of the upper layers of air above the maximum of the North Atlantic Ocean. Prof. Hildebrandsson refers to the recent important researches of Messrs. Rotch, Teisserenc de Bort, Hergesell, Clayton and Maurice, and finally, says that "our results concerning the general circulation of the atmosphere are verified by direct observations made by means of kite flying and free balloons."

The article is accompanied by two very instructive maps showing for summer and winter the mean direction of motion of the upper clouds in relation to the isobars. These charts bring out clearly the east-to-west motion throughout the year of the upper currents over the equator, and the west-to-east motion in the higher latitudes, indicating an enormous whirl of air round the pole.

In another reprint from the same source we have a discussion of two long series of evaporation measures made at the Kremsmunster Observatory; this discussion was undertaken by Prof. P. Franz Schwab, director of the observatory. The observations divide themselves naturally into two groups, the first series being commenced in 1821 and ending in 1845, while the second began in 1865, and is being continued to day.

Prof. Schwab in a series of tables brings together the monthly and yearly values, and treats the daily and annual variations at some length, comparing the latter with results obtained at numerous other stations.

Dietrich Reimer (Berlin, 1906) has published an excellent mean rainfall map of Germany, with explanatory notes which have been prepared by Prof. G. Hellmann. This map, which is on a scale of 1:1,800,000, shows the distribution of the mean yearly rainfall over the land from 3000 stations, the observations from which the values were derived extending from 1893 to 1902. To gain some idea of the distribution of these stations it may be stated that Prussia and the other North German States are represented by 2341 stations, Bavaria by 25, Saxony by 116, Wurttemberg by 90, Baden by 43, Hessen by 32, and Elsass-Lothringen by 70. Thus in North Germany there is one station for every 163 square kilometres, and one for every 205 square kilometres in South Germany. The map gives twelve different shades (ten in blue and two in yellow), and shows at a glance the geographical distribution over this part of Europe.

In the introduction to the meteorological report for the year 1903, published by the Survey Department, Finance Ministry, Cairo, we read that the meteorology series for Abbassia closes with the end of 1903, and that for Helwan begins from January 1, 1904. In this volume we have in the appendices the first instalment of a few discussions relating to the data collected at Abassia since it was started. These are quite brief, but the discussions will no doubt serve to indicate points for future study. Thus, for instance, the large differences in evaporation recorded at the observatory are well worth careful study, and they will no doubt be found to be closely associated with changes of other meteorological elements when a longer series of observations becomes available. The present report includes all the meteorological data collected at the observatory and various out-stations, together with daily readings of the various river gauges situated at different parts of the Nile. The reader's attention should, however, be

directed to the rather long list of errata for this volume given at the beginning of the report

In vol xx, part 1, of the Indian Meteorological Memoirs, we have the first instalment of what we hope will be a series of valuable contributions to the meteorology of the upper air in India

Up to the present time Indian meteorologists have been considerably hampered in dealing with the air circulation over India, as the only fact which existed from which they could form any idea of the air currents in the upper strata was the movement of clouds

A systematic investigation of the upper air began, however, last year, and the chief points of the inquiry in the first instance are to determine the distinctive features of the monsoon currents as regards their depths temperature and velocity gradients and humidity distributions

In the present memoir written by Mr F H Field, deputy meteorologist, and published under the direction of Dr G T Walker reference is naturally made more to the instruments employed and the methods of using them than to the observations recorded Advantage has naturally been taken of the experience of other workers in the field and the English, American, and German systems have all received careful study

The greatest height as yet reached is 1380 metres, and some details are given as to the records of the self-registering instruments employed during the flights made in August and September last when this elevation was reached

The importance of this method of investigation will at once be seen when it is noted that accurate measurements can be made of the elevation of the stratum of saturated air day by day Thus we read that "a nearly saturated stratum of air from the sea extended from the ground surface (about 10 metres above the sea) upwards to a level which rose from 500 metres on August 27 through 800 metres on August 28 to 1130 metres on August 31 From that day onward till September 9 its limiting height was not reached by the kite but probably exceeded 1000 metres its upper limit fell again by September 12 to 600 metres"

The reader is referred to the memoir itself for details regarding the apparatus used and the various interesting meteorological curves given relative to the numerous flights made

FURTHER RESULTS OF THE JESUP NORTH PACIFIC EXPEDITION

THE recently published memoirs of the Jesup North Pacific Expedition maintain the excellence both as to matter and illustration of the previous volumes Mr Swanton[1] gives an account of the religious ideas and social organisation of the Haida Indians, who, to the number of about 600, occupy the towns of Skidegate and Masset, Queen Charlotte Islands The whole Haida stock is divided into two "clans," the Raven clan and the Eagle clan the significance of the division being purely social Each is strictly exogamic, a Raven man being compelled to marry an Eagle woman, and an Eagle man a Raven woman while the children always belong to their mother's clan A man of the Raven clan was reckoned in that clan wherever he might go and the Ravens among whom he settled were his uncles, elder and younger brothers sisters and nephews The members of the opposite clan were frequently considered downright enemies "Even husbands and wives did not hesitate to betray each other to death in the interest of their own families At times it almost appears as if each marriage were an alliance between opposing tribes a man begetting offspring rather for his wife than for himself, and being inclined to see his real descendants rather in his sister's children than in his own" (p 62)

The Raven and the Eagle do not seem to have been deities or deified ancestors "A West Coast man said that the people sometimes left food for a raven on the beach, and, when it got near them told it to give them some thing' Another man however, said "they did not sacrifice to it or pray to it, because it stole too much as it was' And although Eagle was called "grandfather" by men of the Eagle clan, as Raven was called "grandfather" by the Ravens, this was not because either was regarded as a direct ancestor, "but because they had been prominent heroes of the mythical period, and belonged respectively to the Eagle and Raven clans"

The clans were divided into an indefinite number of "families," and the "family" is the fundamental unit in Haida society These usually take their names from towns or camping grounds, and are simply local groups The "family" was divided into households, and there were thus house chiefs, family chiefs, and town chiefs

The families had certain prerogatives which they guarded jealously, such as the right to use certain personal, house, and canoe names and the right to wear certain objects or representations of objects, and to carve them upon their houses or property 'These latter I have called 'crests' They were generally representations of animals, but trees, shells, and figures of objects used in daily life also occur They were originally obtained from some supernatural being or by purchase from another family" The author is wise in refraining from the use of the word *totem* in this connection for, as he justly remarks, "they have no proper totemic significance, their use being similar to that of the quarterings in heraldry, to mark the social position of the wearers", but the name "totem-pole" has crept in beneath the illustrations of the poles carved with crests, placed on front of the houses (Plates i–iii)

The author is of opinion that the 'crest system" was 'rooted in religion,' and that it may have developed from the personal manitou" (p 112)

The study of the Haida social organisation is of peculiar interest since it is possible to view the conflict actually going on between the purely maternal family organisation and the paternal property laws and the complexities resulting therefrom It is to be hoped that future observers will apply Dr Rivers's genealogical methods to the investigation of the sociology of these and other American tribes, as it would be sure to yield important results This method, however, was not published in time for Mr Swanton to utilise it

Turning to religious beliefs the Haida world is peopled with supernatural beings of the air, sea, and land, the sun is of comparative unimportance and the moon belongs to the Raven clan The chief of the Haida deities is Power-of-the-Shining-Heavens who gives "power" to all things, he is prayed to in sickness or sorrow and the clouds are his blankets Owing to the character of the country, the entanglement of land and sea, and the impenetrable nature of the interior, all communication must be by sea, and the supernatural beings of the sea have thus attained an exaggerated importance but a supernatural being can be destroyed "by cutting its body in two and throwing a whetstone between the severed portions In their endeavours to coalesce the two parts then grind themselves to nothing"

The shaman was "possessed" by a supernatural being, and became for the time being the supernatural being himself The calling was generally hereditary in the family, descending from maternal uncle to nephew but the youth had to qualify himself by training "Spirits would come and look around a village to find 'one who was clean' through whom they would act" To become "clean" a man had to abstain from food for a long time A spirit once looking through the smoke-hole of a house, saw a youth lying almost dead, "but he was so 'clean' that he looked transparent 'like glass' So the spirit entered him"

The volume, which is profusely illustrated deals also with secret societies and potlatches or the ceremonial giving away of property, and contains nearly 200 Haida stories

The third and last part of the volume of the Kwakiutl texts[1] collected by Dr Boas and Mr Hunt is now published These folk-tales form a mine of treasures for the folklorist and are especially valuable as giving unbiased and unconscious evidence concerning custom and belief

[1] Contributions to the Ethnology of the Haida By J R Swanton. Jesup North Pacific Expedition, vol v part i, 1905

[1] "Kwakiutl Texts' By Franz Boas and George Hunt Jesup North Pacific Expedition, vol iii part iii, 1905

Numerous songs are given, many being songs of cannibals The volume concludes with a *précis* of each tale The authors are to be congratulated on the termination of what must have been a laborious piece of work

The study of the religion and myths of the Koryak[1] is of particular interest, since these people are very little known, and they seem to have been successful in resisting the efforts of the Russians to convert them to Christianity, and to have preserved their primitive religion to a considerable extent

The Supreme Being occupies an important position in the religious life of the Koryak, but the conception of him is vague Nothing is known of his world-creating activity, except that he sent down Big Raven to our earth to establish order, and Big Raven is the founder of the world The One-on-High plays no active part in the myths which occupy more than one-half of the volume, these deal almost exclusively with the life, travels, adventures, and tricks of Big Raven, his children, and other relatives The value of this record is greatly increased by a comparison of the Koryak myths with Kamchadal, Chukchee, Yukaghir, Mongol-Turk, and American mythologies

Descriptions are given of the festivals and sacrifices, and customs at birth, death, and funerals many of the charms and sacred implements, and some of the ceremonies, are illustrated from photographs and drawings

A C Haddon

[1] "The Koryak, Religion and Myths. By Waldemar Jochelson Jesup North Pacific Expedition, vol. vi part 1, 1905

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Cambridge —The electors to the Isaac Newton studentships give notice that in accordance with the regulations an election to a studentship will be held in the Lent term 1907 These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics The studentship will be tenable for the term of three years from April 15, 1907 The emolument of the student will be 200*l* per annum, provided that the income of the fund is capable of bearing such charge Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1907, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit

The State medicine syndicate reports that it has held two examinations in tropical medicine and hygiene during the past year At the January examination six candidates presented themselves three of whom passed and received diplomas At the August examination eleven candidates presented themselves, of whom ten passed and received diplomas The syndicate proposes to contribute out of the funds in its hands the sum of 150*l* annually as part of the stipend of the reader in hygiene

Mr Ernest Gardner, M P has been appointed a member of the board of electors to the professorship of agriculture and Sir Walter Gilbey, Bart, an additional member of the board of agricultural studies

The following have been appointed examiners for the natural sciences tripos —physics, Mr C T R Wilson and Mr J A McClelland chemistry, Dr Fenton and Mr H B Baker (Oxford), mineralogy, Mr A Hutchinson and Mr H L Bowman (Oxford), geology Mr P Lake and Mr E J Garwood botany, Mr F F Blackman and Mr A G Tansley, zoology, Prof E W MacBride and Mr R C Punnett, physiology, Mr F G Hopkins and Dr T G Brodie (London), and human anatomy, Mr T Manners Smith and Dr A Robinson (Victoria)

The Mark Quested exhibition of 60*l* a year for three years ending Christmas, 1909 has been awarded to F A Potts, of Trinity Hall, assistant to the superintendent of the museum of zoology

The honorary degree of LL D has been conferred upon Sir W H Perkin F R S, by the Johns Hopkins University, Baltimore

A new building for the engineering department of the University of Pennsylvania was formally dedicated on October 19, and is said to be the largest and best equipped structure devoted to engineering education in the United States The cost, including equipment was 200,000*l*

The council of University College London, has received from the committee and subscribers of the Carey Foster Testimonial Fund the sum of 143*l* to be applied in the award of an annual prize in physics, to be known as the Carey Foster research prize This fund is the balance of that raised for the portrait of Dr Carey Foster which was presented to the council in July last

We learn from *Science* that the Georgia Legislature has appropriated 20,000*l* to erect and equip a building for the Agricultural College, and that the New York State College of Agriculture at Cornell University has received a gift of 6000*l* for the foundation of six agricultural scholarships Our contemporary also states that the University of Florida has been removed during the summer from its former position at Lake City to new grounds and new buildings at Gainsville, Fla The new grounds comprise a tract of five hundred acres just outside the city limits of Gainsville

In his report for 1906 on secondary education in Scotland, Dr J Struthers the secretary to the Scotch Education Department, devotes a section to the teaching of science After directing attention to the satisfactory progress made in the secondary schools of Scotland in developing a sound and well-considered course of experimental science, the secretary remarks on a common mistake in the practice of science teachers in allowing inadequate time for the discussion of experimental exercises As one of the inspectors reported to the Department, "unless frequent occasions are afforded for conference on class results, divergences, and conclusions, the work is apt to degenerate into a series of more or less isolated operations in which the pupils are found, not only lacking in their grasp of the subjects of study, but deficient in their knowledge of the units they are using and in their understanding of the constants they have determined" This failing is not confined to Scottish schools, and teachers would do well to take every precaution that the experiments do not degenerate into mere recipes unintelligently worked through by the pupils Unless the pupils acquire a comprehensive idea of the meaning of series of connected experiments they are obtaining little help in learning how to employ scientific methods

SOCIETIES AND ACADEMIES

London

Royal Society, June 21 —"Experimental Evidence of Ionic Migration in the Natural Diffusion of Acids and of Salts —Phenomena in the Diffusion of Electrolytes" By R G **Durrant.** Communicated by W A Shenstone, F R S

Conclusions —The results as given in the present paper appear to afford a considerable body of data tending to support the theory of Nernst and Planck

So far as the author is aware, the method of studying band boundaries has been almost entirely confined to experiments in which batteries have been employed, as in the work of Orme Masson and of Steele

The earlier experiments in jellies and the later experiments with silver nitrate and calcium chloride show that very fairly sharp bands are obtainable without batteries

The evidence goes to show that hydrogen ions move in advance of the diffusion front whereas other ions produce their various "effects" in the rear of the diffusion front

Entomological Society October 3 —Mr F Merrifield, president, in the chair —*Exhibitions* —Commander J J **Walker** A specimen of *Calosoma sycophanta* taken in Denny Wood, New Forest June 16 *Lygaeus equestris* L, found in the Isle of Sheppey on September 22 *Sitaris muralis* taken near Oxford in August by Mr A H Hamm varieties of *Vanessa urticae* *Argynnis adippe* *Lycaena icarus* ♂, and of an almost black form of *Strenia clathrata* occurring at Streatley Berks in August —all

taken this year.—G. T. **Porritt**: A series of *Abraxas grossulariata*, var. *varleyata*, bred this year from a pairing of the variety, all the brood being of the variety, none showing the least tendency to revert to the ordinary form.—C. P. **Pickett**: A gynandromorphous specimen of *Angerona prunaria* bred by him, and a ♂ specimen of *Fidonia atomaria*, caught at Folkestone, with six wings.—J. W. and H. **Campion**: Specimens of the rare dragon-fly *Sympetrum flaveolum*, taken near Epping in August last. It was suggested that these were part of a migration of the species such as occasionally takes place.—Dr. F. A. **Dixey**: Specimens of *Nychitona medusa*, Cram., *Pseudopontia paradoxa*, Feld., *Terias senegalensis*, Boisd., *Leuceronia pharis*, Boisd., and *I. argia*, Fabr. Although there does not exist any direct evidence that the members of the genus Nychitona are distasteful, their habits are such as to suggest this mode of protection, and there is little doubt that they have served as models for other insects.—H. St. J. **Donisthorpe**: Examples of *Dinarda pygmaea*, Wasm., with our other three species, *D. hagensi*, Wasm., *D. dentata*, Gr., and *D. maerkeli*, Kies., with their respective hosts.—Dr. N. **Joy**: Species of Coleoptera first recognised as British in 1906, a variety of *Lathrobium elongatum*, L., from South Devon, with entirely black elytra, and which he proposed to call var. *nigrum*, a curious dull aberration of *Apteropeda globosa*, Ill., *Heterothops nigra*, Kr., taken in moles' nests, and a species of Gnathoncus differing in certain characters from *G. rotundatus*, Kugel, and which occurs almost exclusively in birds' nests.—G. B. **Oliver**: A melanic ♀ of *Acidalia marginepunctata*, Goeze, and a melanic ♂ of *A. subsericeata*, Haw., both taken in North Cornwall this summer, together with the typical forms for comparison, also a dark aberration of *Coenonympha pamphilus*, Linn., taken in the same district.—**President**: A series of *Selenia bilunaria*, illustrating the remarkable angulation of the wings in these examples.—*Papers*.—The formation of a new nest by *Lasius niger*, the common black ant: H. W. **Southcombe**.—Some notes on the dominant Müllerian group of butterflies from the Potaro River district of British Guiana: W. J. **Kaye**.—A contribution to the classification of the coleopterous family Passalidæ: G. J. **Arrow**.

October 17.—Mr. F. Merrifield, president, in the chair.—*Exhibitions*.—H. St. J. **Donisthorpe**: Living specimens of the beetle *Mononychus pseudacori* found in plants of *Iris foetidissima* found at Niton, Isle of Wight.—A. H. **Jones**: A collection of butterflies from Arosa, Switzerland, at 6000 feet, and varieties of *Melanargia galatea* and *Argynnis niobe*, ♀, taken on the Splugen Pass in July, also specimens from other localities for comparison.—W. J. **Kaye**: A fine example of the remarkable moth *Dracenta rusina*, Druce, from Trinidad. The species bears a wonderful resemblance to a decayed dead leaf, the patches on the wings suggesting the work of some leaf-mining insect.—E. M. **Dadd** showed a number of Noctuids common to the British Isles and Germany, and directed attention to the constant differences between the prevalent forms occurring in England and the prevailing forms of the same species on the Continent.—Dr. F. A. **Dixey**: Specimens of *Ixias baliensis*, Fruhst., and *Huphina nerissa*, Fabr., remarking that the association between the two species must necessarily be Müllerian, and not Batesian.—S. A. **Neave**: A number of Lepidoptera selected from the collection made by him in N.E. Rhodesia, in 1904 and 1905, comprising the following rare and remarkable species:—*Melanitis libya*, Distant, *Liptena homeyeri*, Dewitz, *Pentila peucetia*, Hew., *Catochrysops gigantea*, Trim., *Crenis pechueli*, Dewitz, and *Crenis rosa*, Hew., which are evidently two distinct species, and *Crenidomimas concordia*, Hopff., the mimic of the last two species. Also two remarkable species of the genus Aphnæus—including the female, so rarely taken in this genus—*Acraea natalica*, Boisd., and *Acraea anemosa*, Hew., with two remarkable moths showing a close mimetic resemblance to them. The exhibitor further stated that his collection should prove interesting as regards seasonal forms, especially in the Acræinæ and Pierinæ, of which he showed additional examples.

Royal Microscopical Society, October 17.—Mr. A. N. Disney, vice-president, in the chair.—*Cornuvia serpula*, a species of Mycetozoa new to Britain: J. M. **Coon**. For the first time a complete description was given of all the stages of this organism, previous descriptions being limited to the mature plasmodicarp and its contents.

Physical Society, October 26.—Prof. J. Perry, F.R.S., president, in the chair.—The strength and behaviour of ductile materials under combined stress: W. A. **Scoble**. In former tests of materials under combined stress either the ultimate strength or elastic limit stress has been considered, and the tensions have been applied either directly, or by internal pressure in the case of thin tubes, so that the distribution of stress was approximately uniform. The present experiments were made on bars ¾-inch diameter, subjected to bending and twisting to reproduce the irregular distribution of stress occurring in practice. The yield-point was selected as the criterion of strength, but it is open to more than one specification. Here the stress corresponding to the first sign of yield was not taken, but that given by the intersection of the two parts of the stress-strain diagram corresponding to perfect elasticity and complete yield, so that the intermediate state was neglected. The critical bending moment was found to be greater than the yield torque, 2660 and 2400 lbs. ins., and plotting the corresponding bending and twisting moments the ellipse gave the closest approximation to the results.—The behaviour of iron under weak periodic magnetising forces: J. M. **Baldwin**. The behaviour of iron in strong alternating fields has been studied by many observers, and the induction in iron when placed in both strong and weak fields has been thoroughly examined by static methods, but up to the present no results have been published of the induction in weak alternating fields. The author has now, however, succeeded, by means of Lyle's wave-tracer (for description of which see *Phil. Mag.*, vol. vi., p. 549), in examining the induction in periodically varying fields down to extremely low amplitudes. The principal points brought out are as follows:—(1) the permeability satisfies a linear law through a considerable range for weak fields, diminishing to a minimum about 150 as the amplitude of the field diminishes; (2) as the field diminishes the difference in phase between the induction and the magnetising force tends to disappear; and (3) at the same time the hysteresis losses become very small; (4) frequency at these low values of the field has practically no influence on the results obtained.—Fluorescence and magnetic rotation spectra of sodium vapour and their analysis: Prof. R. W. **Wood**. After recapitulating the descriptions of the experimental arrangements given in previous papers, the author describes the work done during the present year in photographing magnetic rotation and fluorescent spectra. A 12-feet grating, a specially constructed three-prism spectrograph, and a monochromatic illuminator were used.

Challenger Society, October 31.—Prof. d'A. W. Thompson in the chair.—Preliminary note on a method of detecting successive moults of the same species among Crustacea: Dr. **Fowler**. The uncertainty of connecting together in series the successive stages of larvæ captured in tow-net hauls is great, especially if the general form and appendages differ at different moults. Brooks noticed twenty years ago a curious numerical relation between the lengths of four specimens of stomatopod larvæ, which appears to be capable of expansion into a regular law, and if the larvæ captured be sorted at first by general morphological similarity and by constant association in the same hauls, it seems probable that this law will give the key to their relationship. The author had measured and sexed more than 400 specimens of *Conchoecia subarcuata*, Claus = *macrocheira*, Müller. The males and females each fell into three groups when arranged by lengths, when the frequency of the lengths occurring in each group was plotted each formed a small "curve of frequency," and the mean length of each group when multiplied by a certain factor (found experimentally) yielded the mean of the next highest group, the extremes, similarly multiplied, yielded, approximately, the extremes of the next highest curve. The factor is different for males and for females, and seems to be an expression of

the percentage of its total length by which the animal increases between two moults, this is apparently constant for every moult This law is also very clearly observable when applied to the measurements of lobster larvæ recorded by Herrick—Three graphic methods of recording temperature observations in use in the section of the International Investigations of the North Sea conducted by the Scottish Fishery Board Prof d'A **Thompson.** One method recorded the surface temperatures at any date and any position along a given line, another the temperature at any date and depth at a given position, the third showed the daily sequence of temperatures for the year at any given position in the form of sine curves

Linnean Society, November 1—Prof W A Herdman, F R S, president, in the chair—The structure of bamboo leaves Sir Dietrich **Brandis.** While the leaves of other grasses exhibit a great variety of structure, those of bamboos are exceedingly uniform In bud they are always convolute, they all have in the upper epidermis, alternating with the longitudinal nerves, bands of large bulliform cells known as motor-cells In most species these motor-cells are filled, entirely or partially, with solid bodies of silica Between the bands of bulliform cells and the longitudinal nerves, bamboos (with one exception so far as known, *Chusquea pinifolia*, of south-east Brazil) have large apparent cavities, which are completely filled by large flat thin-walled cells, lying one over the other, like the leaves of a book This tissue is entirely different from that which in a young state, fills the cavities in the leaves of *Glyceria aquatica*, *G fluitans*, and other aquatic grasses The species placed by Dr Stapf in "Flora Capensis" in the new tribe Phareæ have, so far as known, leaves with a structure similar to bamboo—Crustacea from the Inland Sea of Japan Dr J G **De Man** Thirty-nine species were fully described, and ambiguities in previous authors cleared up—The systematic position of *Hectorella caespitosa*, Hook f Prof A J **Ewart** This plant has been regarded as belonging to the Portulaceæ, but the author suggested it might be transferred to the Caryophyllaceæ

Mathematical Society, November 8—Annual general meeting—Prof A R Forsyth president, in the chair—Partial differential equations some criticisms and some suggestions Presidential address by Prof **Forsyth** The address dealt chiefly with the present state of the methods of practical integration, a number of exceptional cases in regard either to method or classification, were pointed out, and various gaps in the theory were indicated Some suggestions as to hopeful lines of advance were made—Harmonic expansions of functions of two variables Prof A C **Dixon** A function of two real variables having a considerable degree of generality, is expanded in a double series each term of which is the product of two functions containing the two variables separately, and also containing parameters which differ from term to term of the series The series is transformed into a multiple integral The series that are founded on this expansion are found to be equally complete with double Fourier's series—The inversion of a definite integral H **Bateman** The paper contains a classification of integral equations of the first kind, two practical methods of proceeding to a solution and a number of illustrative examples—Partial differential coefficients and repeated limits in general Dr E W **Hobson.** Among the matters treated is the formulation of the most general conditions in which the equation

$$\frac{\partial}{\partial x}\left(\frac{\partial u}{\partial y}\right)=\frac{\partial}{\partial y}\left(\frac{\partial u}{\partial x}\right)$$

holds good—Bäcklund's transformation and the partial differential equation $s=F(x, y, z)$ J E **Campbell** The form of differential equation in the title includes the differential equation of all pseudospheres, or surfaces of constant negative curvature In this case the equation admits of being transformed into itself by a transformation due to Bäcklund The transformation succeeds also in one other case—Subgroups of a finite Abelian group H **Hilton**—The general solution of Laplace's equation in n dimensions G N **Watson.**

Manchester

Literary and Philosophical Society, October 26—Sir William H Bailey, president, in the chair—A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency Prof W J **Pope** and W **Barlow**

October 30—Mr Charles Bailey in the chair—(1) A journey to North-East Rhodesia during 1904 and 1905, (2) a collection of birds from North East Rhodesia S A **Neave**

Paris

Academy of Sciences, November 5—M H Poincaré in the chair—The alcoholysis of fatty bodies A **Haller.** The hydrolysis of fatty substances by an aqueous solution of various acids is well known The author has found that if the acids are employed in alcoholic instead of aqueous solution the glycerol is split off as before, but the alkyl ester of the acid is formed, and hence the process may be fitly called alcoholysis All fatty bodies whatever their constitution or consistency, undergo this change with more or less facility Full details are given of the methods used in carrying out this reaction, which has been applied to a large number of glycerides Owing to the low temperature at which the reaction can be completed, the replacement of water by alcohol possesses certain advantages—The transformation of volcanic rocks into phosphate of alumina under the influence of products of physiological origin A **Lacroix** The change takes place under the influence of the excrement of sea birds—The seeds and flowers of Callipteris M **Grand'Eury** The frequent presence, along with Callipteris, in the neighbourhood of Autun, of seeds catalogued thirty years ago under the name of *Carpolithes variabilis*, found with an intimate mixture of the same seeds with *Call conferta* in the coal deposits of Bert, formed exclusively of this fossil, led the author to the view that these belonged to the same plants In the present paper an account is given of a study of the flora of the Autun boghead which confirms this view—The perturbations of Vesta depending on the product of the masses of Jupiter and Mars M **Leveau**—Certain linear groups Léon **Autonne**—The potentials of an attracting volume the density of which satisfies the equation of Laplace A **Korn**—Certain kathode rays P **Villard** Some remarks on the nature of the non-deviable rays observed in a Crookes's bulb by J J Thomson—The establishment of an exclusive correspondence independent of syntonisation, between a transmitting post and one of the receiving posts of a wireless telemechanical installation Edouard **Branly**—The conditions of precipitation and re-dissolution of metallic sulphides H **Baubigny** Remarks on a paper by M G Bruni and Padoa, the author referring to papers by himself on the same subject published in 1882 and 1889—The gases observed in the attack of tantalite by potash C **Chabrié** and F **Levallois** Experiments on tantalite and the corresponding ferrous titanate show that the hydrogen observed in the reaction with potash is not present in the mineral, but is due to a chemical reaction between ferrous oxide and the alkali—Contribution to the study of selenium Œchsner **de Coninck** By the reduction of selenious oxide by glucose, an amorphous brick-red selenium is produced This dissolves gradually in concentrated sulphuric acid forming $SeSO_3$ This latter substance in contact with water deposits a new stable variety of selenium, the properties of which are detailed—The chlorination of paraldehyde and on butyric chloral P **Freundler**—Phenyl migration the structure of the intermediate compounds M **Tiffeneau**—Study of the constitutional formulæ of some dimethylanthracenes James **Lavaux**—The toxicity of some rare earths their action on various fermentations Alexandre **Hébert** The sulphates of thorium cerium lanthanum, and zirconium possess certain toxic powers Experiments on frogs, fish, the seeds of plants, Aspergillus yeast, diastase and emulsin are described—An albumin extracted from the eggs of fish comparison with the vitelline from hens eggs L **Hugounenq** By hydrolysis with dilute sulphuric acid the albumin from the egg of *Clupea Harengus* (clupeovine) gave arginine histidine lysine aminovaleric acid tyrosine leucine, alanine serine phenylalanine and aspartic acid These correspond closely

with the products of hydrolysis of egg-albumin, but the ratios in which the various substances are produced differ in the two cases —The liquid crystals of ammonium oleate Fred **Wallerant.**—The indirect actions of electricity on germination Pierre **Lesage** —The histological structure and development of the osseous tissue in ectromelian monsters J **Salmon** —Cytology and pathogeny of spermatic cysts J **Sabrazès.**—The development of polygenesis and the theory of concrescence Jan **Tur** —The dislocations of the edge of the Central Plateau between Voulte and Vans (Ardèche) Émile **Haug.**—The Jurassic strata in Greece Carl **Renz.**—The archæan substratum of the globe and the mechanism of geodynamical actions E **Jourdy.**—The circumzenithal rainbow Louis **Besson**

NEW SOUTH WALES

Linnean Society, September 26 —Mr T S eel, president, in the chair —The sound (and lake) basins of New Zealand and the cañons of Eastern Australia in their bearing on the theory of the peneplain E C **Andrews.** An attempt from an examination of Eastern Australian and New Zealand geographical types, to prove Prof Davis's contention that the greater number of plateaus of erosion are elevated *peneplains* formed at or near sea-level Streams speedily cut profound cañons, the bases of which, even prior to the passing away of the individuality of the central plateau, approximate closely to the level of the main water body into which they are discharging Large floods determine these channel grades, the normal stream being functional in aggrading the holes formed *below* main or temporary base-level by the storm waters The lake and sound basins of New Zealand represent holes ploughed out below base-level by swiftly converging glaciers and are analogous to the deep flood holes found in river beds —A correlation of contour, climate, and coal a contribution to the physiography of New South Wales T Griffith **Taylor.** It is submitted that the rivers of the Murray Darling system show evidence of the influence of Ferrel's law on their courses The gap in the Great Divide situated near Cassilis is due to the shifting of the Divide by the Goulburn River The cutting action of this river has been determined by the lower "coefficient of resistance" of the Permo-Carboniferous Coal-measures The relation of the temperature lines and of the lines of rainfall is shown to be influenced by this Geocol —The stinging property of the giant nettle-tree (*Laportea gigas* Wedd) Dr J M **Petrie** The physiological action is shown to be due to the free acid existing in a concentrated form in the hairs which are hollow siliceous tubes, and it differs from the sting of the common nettle only in degree Laportea contains ninety times more free acid than the common nettle —A striking example of river-capture in the coastal districts of New South Wales Dr W G **Woolnough** and T Griffith **Taylor** The authors have examined the topographical relations of the bend in the Shoalhaven River near Marulan Field evidence shows the existence of a fairly well-defined ancient river-channel connecting the Shoalhaven and Wollondilly watersheds Along this line are well-defined coarse river-gravels derived from the southward The structure of this former river-channel is described It is pointed out that other instances of capture of Wollondilly water by branches of the Shoalhaven are imminent for instance, in the neighbourhood of Bundanoon —Supplement to the "Revision of the Cicindelidæ of Australia" Dr T G **Sloane.**—Descriptions of new species of Lomaptera (Coleoptera Scarabæidæ, subfamily Cetonides) A M **Lea** Two species are described, from specimens obtained by Mr H Hacker at Coen, N Q, a district which appears to be rich in showy beetles especially in Cetonids and Longicorns

DIARY OF SOCIETIES

THURSDAY, NOVEMBER 15

ROYAL SOCIETY, at 4 30 —Calcium as an Absorbent of Gases, and its Applications in the Production of High Vacua and for Spectroscopic Research F Soddy —A Method of Gauging by Evaporation the Degree of High Vacua (Addendum to Mr F Soddy's Paper) A J Berry —The Effect of Temperature on the Activity of Radium and its Transformation Products Dr H L Bronson —On the Refractive Indices of Gaseous Potassium, Zinc, Cadmium, Mercury Arsenic, Selenium and Tellurium C Cuthbertson and E P Metcalfe.—The Photo-electric Fatigue of Zinc H S Allen

CHEMICAL SOCIETY, at 8.30.—On the Determination of the Rate of Chemical Change by Measurement of Gases Evolved F E E Lamplough. —Xanthoxalanil and its Analogues S Ruhemann

LINNEAN SOCIETY, at 8 —Recent Researches in Norway Horace W Monckton

FRIDAY, NOVEMBER 16

INSTITUTION OF MECHANICAL ENGINEERS, at 8 —Steam as a Motive Power for Public Service Vehicles T Clarkson.

MONDAY, NOVEMBER 19.

LONDON INSTITUTION, at 5 —Musical Sands Cecil Carus-Wilson

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —The Seychelle Islands J Stanley Gardiner

SOCIOLOGICAL SOCIETY, at 8.—Japanese Character Prof Motora.

SOCIETY OF ARTS, at 8 —The Nutrition of the Plant A D Hall.

TUESDAY, NOVEMBER 20.

INSTITUTION OF CIVIL ENGINEERS, at 8 —Single-phase Electric Traction (Discussion) C F Jenkin

ROYAL STATISTICAL SOCIETY, at 5 —Presidential Address Sir Richard B Martin, Bart

ANTHROPOLOGICAL INSTITUTE, at 8 15 —A Visit to the Hopi Indians of Oraibi W Crewdson —On the Relative Statures of Men with Long Heads, Short Heads, and those with Intermediate Heads, in the Museum, Driffield J R Mortimer

WEDNESDAY NOVEMBER 21

ENTOMOLOGICAL SOCIETY, at 8 —Studies of the Blattidæ (ii) R. Shelford —Notes on the Life history of *Trochilium andrenæforme*, Lasp Hon N Charles Rothschild

ROYAL MICROSCOPICAL SOCIETY at 8 —The Use of a Top Stop for Developing Latent Powers of the Microscope J W Gordon

SOCIETY OF ARTS, at 8 —Opening Address by Sir Steuart Colvin Bayley K C S I

ROYAL METEOROLOGICAL SOCIETY, at 7 30.—The International Congress on Polar Exploration at Brussels, September 1906 Dr H R. Mill — The Abnormal Weather of the Past Summer, and some of its Effects W Marriott

GEOLOGICAL SOCIETY at 8 —On the Skull and Greater Portion of the Skeleton of *Goniopholis crassidens*, from the Wealden Shales of Atherfield (Isle of Wight) Reginald W Hooley —The Kimeridge Clay and Corallian Rocks of the Neighbourhood of Brill (Buckinghamshire) A Morley Davies

THURSDAY NOVEMBER 22

ROYAL SOCIETY at 4 30 —*Probable Papers* Studies on the Development of Larval Nephridia, Part ii Polygordius Dr Cresswell Shearer —The Structure of Nerve Fibres Prof J S Macdonald —On Opsonins in Relation to Red Blood Cells Dr J O Wakelin Barratt —On the Inheritance of Certain Invisible Characters in Peas R H Lock —The Influence of Increased Barometric Pressure on Man, No. 2 Leonard Hill, F R S, and M G Greenwood

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Selection and Testing of Materials for Construction of Electric Machinery Prof J Epstein

FRIDAY NOVEMBER 23

PHYSICAL SOCIETY, at 5 —On the Electrical Radiation from Bent Antennæ Prof J A Fleming —Auroral and Sun-spot Frequencies contrasted Dr C Chree —The Electrical Resistance of Alloys Dr R S Willows.

CONTENTS

THURSDAY, NOVEMBER 22, 1906

A BIBLIOGRAPHY OF PHILOSOPHY

Dictionary of Philosophy and Psychology Edited by Prof. J Mark Baldwin Vol iii Two parts Part i, pp xxiv+542, part ii, pp vi+543-1192 (New York: The Macmillan Company, London Macmillan and Co, Ltd, 1905) Price 42s net

WITH the publication of this "Bibliography of Philosophy, Psychology, and Cognate Subjects," Prof Baldwin's great enterprise comes to an end, and he and his collaborators are to be congratulated on the successful completion of a work that will be indispensable to the teacher and student of philosophy The compiler of this latest volume, Dr Benjamin Rand, of Harvard, will in particular receive the thanks of those who hitherto have painfully had to make their own bibliographies from *Jahresberichte* and various popular indexes and who in the fulness of their ignorance have not been able to neglect even the humble catalogue of the Leipzig bookseller

The work does not profess to give references to books and articles that have appeared since 1902, but up to that date it seems to be very complete, at any rate a first perusal does not reveal very startling omissions Psychology is, of course, one of the strongest features of the Dictionary, and of this present volume, of which it occupies 280 pages, and the editor points out in a prefatory note that the annual volumes of the Psychological Index from 1902 may be regarded as a supplement of this Dictionary Accordingly, those who possess this Dictionary and secure the index each year from 1902 "will have for Psychology an exhaustive Bibliography, and for the other topics of this volume one that is selective and fairly adequate, continuing indefinitely into the future"

The scheme of the volume seems to cover all the ground, and the headings are well arranged The first part is occupied with a few pages containing a bibliography of bibliographies, then about fifty pages of general works on the history of philosophy, then come about 500 pages on philosophers, their works, and works upon them We note that Aristotle has twenty-four pages assigned to him, Darwin five, Kant thirty-four, and Plato nineteen Naturally there has been some hesitation in selecting for this columbarium any but the most prominent of living philosophers, Wundt is there, and Bain (though he was alive in 1902), but not Mr F H Bradley or Mr Shadworth Hodgson Those, however, who have not attained a place beside Plato and Aristotle, and some six hundred of the majestic dead, have tardy justice done them under the later head "Systematic Philosophy Systems and Essays" Under systematic philosophy we have such further headings as atomism, evolution (only eight pages!), materialism, positivism, teleology, and the like Then come the sections of logic, æsthetics, philosophy of religion ethics, and psychology The biologist and the student of the physical side of mental processes will note that to the brain and its functions are given fifteen pages, to heredity two to the nervous system ten, to sensation and the senses about thirty-eight The arrangement under each heading is, of course alphabetical according to the names of the writers, which are generally printed in heavy type The main references to epoch-making works—and to some not epoch-making—are followed immediately by a note of the important reviews that greeted their appearance One must heartily commend the fulness with which, *e g* under atomism, we have the references to Aristotle's discussions of the topic Phys II, 4 196 a 25, III, 4 203 a 22 But perhaps in dealing with important Greek and Latin authors an attempt should have been made to distinguish translations and commentaries

Without being captious, however, we must complain that the number of misprints is a little too large It is irritating to have to inquire whether some new writer or thinker has suddenly appeared whose name differs from someone of comparative fame only in one of the initial letters H for A, or G for S or C for F Such misprints must occur, but woe to the editor or proof-reader of a bibliography in which misprints attain more than a certain proportion

THE ROMANCE OF THE EARTH AND MAN

The Human Epic The Prehistoric Story of Mankind By John Frederick Rowbotham Pp 214 (London Gay and Bird, n d)

THE author of this remarkable publication, like the Mayor of Coquerico in "Genevieve de Brabant," is by no means averse to blowing his own trumpet, accordingly he announces to the world at large on the title-page of his work, that it is "the twelfth Epic Poem of the world", he also modestly states that he is "The Homer of Modern Times" Such courage deserves our applause, even if we fail to recognise the modern representative of Greek poetry in Mr Rowbotham

The author begins with the evolution of the earth and the origin of life and strives to show the changes undergone by the inorganic world and the gradual appearance of lowly marine beings in the Cambrian and Silurian seas Of poetic fancies the author nothing lacks, but of natural history lore his stock is meagre —

"Much fear I him who armed with claws and quills
Steals stealthily along the weedy mire
I dread the shape who bears the bristling gills
Which seem with rage and venom to respire
But chiefly do I fear the lobster dire
Four claws he wears, his quarry to assail,
Two spears he brandishes to wreak his ire,
Invulnerable gleams his quilted mail
O'er such stupendous foe nought living can prevail"
(p 27, v 35)

We are quite at a loss to fit the author's description with any Silurian, or, indeed, any other fossil arthropod!

We are next favoured with a view of the Old Red Sandstone period and its armoured fishes, then of the "Age of Trees"—"One mighty Sunderbund earth's surface seemed which with evaporating moisture steamed," but though we surmise this to be a view

of the Coal period, the author does not hint at any definite geological fact, save that mosses and *bull-rushes* (query Equisetaceæ) became gigantic trees After upheavals in the Permian period we arrive at the "Age of Monsters," by which the author means the Ichthyosaurus and the Plesiosaurus, which (after Blake's picture in Hawkins's "Sea Dragons") have a mighty battle, the Ichthyosaurus coming off conqueror We are next *introduced to* "The Giant Newt" (probably the Pariasaurus?), then to the Atlantosaurus, moving with his head in the clouds! Pages of grandiloquent poetry, after the pattern of Pope's translation of Homer's Iliad, are devoted to an impossible battle between herds of armed herbivorous Dinosaurs and armies of carnivorous ones, the author apparently being unaware that the latter were extremely few in number compared with the former, just as the herbivorous mammals were as a thousand to one carnivore on the African plains before "man the destroyer" came upon the scene with his "shooting-iron"

> ' And howls of anguish and of beasts dismayed
> Strike on the air In crowded cohort stand
> The monsters of the plains, begirt on every hand
> Their roaring foes less huge, but of a shape
> Obscene and foul beyond a parallel,
> Rush on to decimate with jaws agape
> The remnants thus enclosed These slowly fell" (p. 58, vv 40, 41)

In canto the tenth the author gives us "A Day with an Iguanodon," and with the late Mr J L Toole we are inclined to exclaim, "oh! what a day we are having"

> "In ten enormous strides he fared a mile
> Towering above the tree tops as he strode
> He soon was in his den amid the ferns bestowed" (p 69, v 31)

In the eleventh canto we reach the Tertiary period, and have the first glimpse of ape-like man reflecting on the scene from a tree overlooking a pool at which the Dinotherium, Palæotherium, Anoplotherium, Mastodon, Dinoceras, Megatherium, and Mylodon (as was their habit!) came down to slake their afternoon thirst The author is so pleased with this idea that he repeats on pp 76, 77, vv 32 and 38 and p 82 v 15, the same scene

He goes on (in canto thirteen) to describe "The Earthly Paradise," and on pp 85, 86, gives an unlovely picture of humanity in its early stage, but on p 87, vv 27-34, evolves from the baser herd a superior pair endowed with finer instincts, but on p 89, v 35 he admits —

> "Yet were they both but brutish beasts amid
> That garden of delights, that Paradise, ' &c
> The male on lank and shaggy shanks upreared,
> Whose breast and back unsightly bristles drape
> Whose monstrous snout protuberant appeared,
> Whose brutish jaws seemed evermore to gape
> With teeth and tusks of dire revolting shape" (p 89, v 36)

The flood follows, then cave-dwellers are depicted, and the use made of stones as weapons, of skins as clothing, and the discovery of fire making, the sling, the spear, bow and arrow, and so on

The whole material is woven up into a poetic and exaggerated form which to our way of thinking, renders it highly unsatisfactory Kitchen-middens, lake-dwellings, the continent of Atlantis, the capture of the first horse, the potter's art, the origin of ornaments, of music, singing and dancing, are introduced Then legends are touched upon, the domestication of the dog, the wandering minstrel, and, lastly, a legend of the "Ice age" into which we cannot follow the learned author Mr Rowbotham's legendary lore and his talent for versification may be admirable, but his geology and palæozoology are extremely shady, and we do not recommend him as a guide to follow in his reconstructions of the past history of the earth or of prehistoric man

MATHEMATICS FOR SCHOOLS

(1) *Elementary Geometry based on Euclid's Elements* By F Purser Pp vii+121 (Dublin Hodges, Figgis and Co, Ltd, London Longmans, Green and Co, 1906)

(2) *Geometry, Theoretical and Practical* Part 1 By W P Workman and A G Cracknell Pp x+355 (London University Tutorial Press, Ltd, 1906) Price 3s 6d

(3) *Elementary Geometry* Books vi and vii By W M Baker and A A Bourne Pp 390-477 (London G Bell and Sons, 1906) Price 1s 6d

(4) *A Shilling Arithmetic* By S L Loney and L W Grenville Pp 186+xxiv (London Macmillan and Co, Ltd, 1906) Price, with answers, 1s 6d

(5) *Junior Arithmetic with Answers* By W G Borchardt Pp viii+221+xl (London Rivingtons, 1906) Price 2s

(6) *A Junior Arithmetic* By C Pendlebury, assisted by F E Robinson Pp xii+204 (London G Bell and Sons, 1906) Price 1s 6d

(7) *A Preliminary Course in Differential and Integral Calculus* By A H Angus Pp vi+108 (London Longmans, Green and Co, 1906) Price 2s 6d

(8) *A College Algebra* By Prof H B Fine Pp viii+595 (London and Boston Ginn and Co, n d) Price 6s 6d

(9) *A New Trigonometry for Beginners* By R F D'Arcy Pp viii+84 (London Methuen and Co, n d) Price 2s 6d

(10) *Elementary Descriptive Geometry* By C H McLeod Pp ix+118 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1905) Price 6s 6d net

(1) IN Mr Purser's "Geometry" the subject-matter corresponds essentially with that of the first six books of Euclid, and the treatment is on similar lines, but the propositions are differently arranged, and are grouped, with the object of showing the reasons for the sequence adopted Euclid's definitions of parallels and proportion are adhered to, though the defective statement of the former on p 17 must be due to an oversight No exercises are provided, and teachers will find little to induce them to adopt the book in their classes

(2) In the "Geometry" by Messrs Workman and Cracknell we have a very full treatment of angles,

parallels, triangles, parallelograms, and circles, with areas, loci, and symmetrical figures. There is a short introductory course of experimental geometry, followed by a preliminary chapter on the "science of geometry," in which fundamental concepts, axioms, and deductive processes are discussed. Thus prepared, practical work and logical development proceed together. There are exercises in abundance of all types, theoretical, constructive and numerical, the answers to the latter being given. There is a useful index of terms, and a collected list of propositions very convenient for reference. The book should prove of great value to teachers and pupils alike, and seems altogether good.

(3) The new volume by Messrs. Baker and Bourne deals with the geometry of three-dimensional space. Book vi. corresponds with Euclid xi., and Book vii. gives the mensuration of the simple geometrical solids. The high standard of the authors' previous work is maintained. The treatment is clear and concise, the printing is excellent, and useful sets of exercises are provided for class work.

(4) The "Shilling Arithmetic" by Messrs. Loney and Grenville is a handy little volume intended more especially for use in secondary schools, and consisting mainly of a very large collection of graduated examples with explanatory notes. Physical as well as commercial arithmetic is represented, though examples of the latter type predominate. Answers are given at the end, and altogether the book is very suitable for its purpose.

(5) Mr. Borchardt's "Junior Arithmetic" is very like the one just noticed, but more use is made of graphs, the commercial type of exercise is less prominent, and the treatment follows more closely the scheme of the committee of the Mathematical Association. A special feature of the book is a set of 385 examples arranged as a graduated set of fifty-five test papers covering the whole subject. The course will form a good preparation for the Oxford and Cambridge locals, the London matriculation, and similar examinations.

(6) The "Junior Arithmetic" by Messrs. Pendlebury and Robinson is very similar in character to the two just mentioned, and is well suited for use under similar conditions. In all three there are too many exercises of the kind "If 120 men can build a house 60 feet high in 15 days, how many men will it take to build one 55 feet high in 10 days?" But the teacher can delete these and still have ample choice. The book can be obtained with or without answers.

(7) Many students rightly wish to acquire an elementary working knowledge of the calculus at a comparatively early stage. By such the preliminary course of Mr. Angus will be appreciated. The author confines himself to the algebraical, trigonometrical, and exponential functions, and has thus space available for ample illustration. There seems to be a want of clearness in the author's notion of a rate, for instance, on p. 27, where in the expression $dV/dD = \pi D^2/2$, relating to a sphere, V denoting volume, he puts dV equal to 7.5 *cubic inches per second*, a statement which must perplex a thoughtful student. However the book is a good one, and can be recommended to beginners who have some knowledge of squared paper work.

(8) The "College Algebra" by Mr. Fine is a very masterly and fascinating treatment of the subject, whether from the standpoint of logical completeness or of practical computation. The book is divided into two parts, the first and smaller of which establishes the fundamental laws of operation for numbers, rational and irrational, imaginary and complex, the discussion being based "on the notion of cardinal number and the notion of order, as exhibited in the first instance in the natural scale 1, 2, 3. . . ." The second and main part of the work deals most thoroughly with the successive developments, and carries the subject so far as to include, in the later portions, the theory and solution of cubic and biquadratic equations, determinants, the binomial, exponential, and logarithmic series, the properties of continuous functions, &c. The volume is beautifully printed, and whether adopted or not as a text-book in this country, so excellent a treatise should be found in the library of every teacher of mathematics.

(9) As a first course of trigonometry for beginners the elementary text-book of Mr. D'Arcy is well conceived, the work being closely associated with quantitative practical geometry, and being carried only so far as problems on heights and distances and the solution of triangles, complex trigonometrical transformations being wisely absent. At the same time the idea of the book is not well carried out in detail. The style is unattractive, and the illustrations are not very illuminating. The figures are badly printed and sometimes are scarcely legible. More attention might well have been given to the solution of triangles by means of right-angled triangles, and it seems a mistake to have omitted to include the four-figure tables in the text. The book is designed for candidates taking the Cambridge previous or the Cambridge general examination, and test papers at the end contain many questions selected from these examination papers.

(10) The "Descriptive Geometry" by Mr. McLeod is intended as a minimum course for engineering students. It deals in a simple and straightforward manner with elementary problems on points, lines, and planes, polyhedra, curved surfaces and tangent planes, including several skew surfaces, sections, envelopes and developments, trimetric projections, and shadows.

PHOTOGRAPHIC TOPICS

The Complete Photographer. By R. Child Bayley. Pp. xv+410. (London: Methuen and Co., n.d.) Price 10s. 6d. net.

AFTER having read this volume, the question that naturally presents itself to the reviewer is to what class of readers will it appeal? The author, in his preface, states that he has made no attempt to compete with the many books on photography that have already been published, whether scientific treatises upon the principles underlying the practice or manuals of practical instruction. He states, further

and quite correctly, that the formulæ given are very few, and that "it is their application to photography that has formed his topic" The student, therefore, will not always find here the practical instructions that he needs, sometimes, in fact, quite otherwise If, for example, he wishes to varnish a negative, and turns to the page indicated in the index, he reads that "the modern dry-plate worker finds the result of the first operation is to send a stream of varnish up his arm, of the second to make a pool of it on the floor and of the third to cement a number of dust particles to the surface of the negative, and, possibly, to set the whole of the varnish alight" As the author considers that there is no reason why an amateur photographer should varnish his negatives, he does not help him to do it

It is essentially a personal treatise Those subjects that commend themselves to the author he discourses on at length, and sometimes in much detail, others he merely refers to, and in most cases he expresses his own opinions in very decisive terms There are some opinions with which we do not agree, but the volume is easy reading, and if at any time we begin to get annoyed with the expression of views that we are inclined to condemn, a page or two forward is sure to bring us face to face with a charming picture that cannot but please, though it has no connection whatever with the text, except that it is a photograph Photography pure and simple is dealt with in nineteen chapters, then follow chapters on "Dodging and 'Faking,'" landscape architectural work, and portraiture, "Pictorial Photography," "Exhibitions and Societies" and a few pages on photomechanical work

We notice only a few errors, and as most of them are not obvious slips it may be worth while pointing them out Sodium hypochlorite is included among "hypo eliminators", of "very doubtful efficacy" As it is supposed readily to oxidise the thiosulphate to sulphate, experimental evidence should be adduced before its efficacy is doubted The statement at p 157 that a "focal-plane shutter allows the whole of the light which passes through the lens, to fall on any part of the plate which it uncovers" certainly needs amending A few lines lower, a roller blind shutter with an opening that is equal in length to twice the diameter of the lens, and travelling at a uniform rate is stated to leave "the lens fully open for exactly half the time during which it is uncovered at all" For this result the length of the opening should be three times the lens diameter The author must have been misinformed as to the "Linked Ring," for he states that it came into existence by reason of a "personal squabble" in the Royal Photographic Society As he goes on to say that "signs are not wanting that the 'Linked Ring' in its present form has outlived its utility," his attitude appears to be far from friendly towards this Society, but it might have been better if he had refrained from giving his opinion in this place To those who know enough about photography to appreciate it, and there must be a very large number of persons so qualified, the volume will prove both entertaining and instructive

POPULAR NATURAL HISTORY.

(1) *Nature's Story of the Year* By C A. Witchell. Pp xii+276 (London T Fisher Unwin, 1906.) Price 2*s*

(2) *Creatures of the Night* By A W Rees Pp xix+448 (London John Murray, 1905.) Price 6*s* net

(3) *The Life Story of a Fox* By J C Tregarthen Pp viii+224 (London Adam and Charles Black, 1906) Price 6*s*

(4) *The Romance of Animal Arts and Crafts* By Dr H Coupin and John Lea Pp 356 (London Seeley and Co, Ltd, 1907) Price 5*s*

(5) *Our School Out of Doors* By the Hon M Cordelia Leigh Pp xii+141 (London T Fisher Unwin) Price 2*s*

(1) MR WITCHELL is great as an observer He has studied the ways of sticklebacks With still more patience and insight he has watched the courtship of willow-wrens and of skylarks He has much to say about the habits of swifts that is worth reading He is at his best when he is writing about birds, though such an affectionate observer has, of course, the defect of his virtue He sympathises so keenly with his favourites that he reads into their lives a good deal which may or may not be there They are to him beings full of almost human thoughts and passions But whether we go along with him in his inferences or not, he makes it plain that there is a great deal in nature that most of us fail to notice We must regret that he feels so much contempt for comparative anatomy and classification, things of some importance, though Mr Witchell is not alive to it But chiefly we must regret that our author sometimes aims without success at a very high-flown style of writing On p 76 is a notable example In the first chapter he is a philosopher rather than an observer, and for this *rôle* he is not so well qualified But if his readers go on with the book they will find themselves rewarded

(2) Mr Rees's "Creatures of the Night" is a very readable book It is written in good style Though not so exciting as some books of animal biography, it has an air of genuineness and reality Lutra is a real she-otter, Brock is a real badger, and we get interested in Brighteyes the water-vole There is, of course, a tendency to make the heroes of these animal stories too human, but that is inevitable in literature of the kind

(3) Mr Tregarthen's is a book of the same class, but with this difference, that the hero, who tells his own story, is frankly and undisguisedly human He knows, for instance, that the light in the surf on the rocks is due to phosphorescence, an astonishing piece of knowledge for a fox But the story is so well told, is so interesting, and even exciting, that one does not stumble over unrealities of this kind They seem merely to add piquancy In essentials the story is true to life, and it is admirably told

(4) "The Romance of Animal Arts and Crafts" describes the various styles of architecture adopted by different classes of animal from the beaver down to the caddis-worm Rat-kangaroos, badgers, trap-

door spiders, pocket-gophers, robber-crabs, squirrels, ants, tree-frogs, weaver birds, scarab beetles, and many others come in turn upon the stage From the nature of the case, a book that covers so wide a range must be in the main a compilation But the authors add a good many observations of their own Moreover—a very great merit this—they investigate the current animal stories before accepting them as true There is none of the *credo quia mirabile* spirit They tell us, for instance, that the mole's "fortress" is not the highly elaborated structure which a succession of books on natural history have each in turn still further beautified and complicated, but something much more varying and irregular Altogether it is a very interesting book The illustrations, not very numerous, are good

(5) "Our School Out of Doors" is a book of a very different type It contains a great deal of correct information on interesting subjects, but it is too miscellaneous, and it suffers from the plan on which it is arranged Intended for the use of school teachers, it has one or more chapters for each month This shifting from one subject to another, each very briefly and imperfectly explained, cannot be good for pupil or teacher In May, Composite flowers are, apparently, to be studied before the pupil has any knowledge of the structure of a common buttercup In August, five pages are devoted to "watery wonders" It would be far better to study some of the subjects more thoroughly and to neglect others altogether

OUR BOOK SHELF

Hints to Travellers, Scientific and General Edited for the Council of the Royal Geographical Society by E A Reeves Ninth edition, revised and enlarged Two vols Vol i, pp xi+470, vol ii, pp v+286 (London Royal Geographical Society, 1906) Price 15s net

IN editing this ninth edition of the well-known "Hints," Mr Reeves has taken a point of view somewhat different from that of his predecessor, Mr John Coles, in the earlier editions He says —"As the days of the pioneer explorer of the old type are fast drawing to a close more exact surveys are required than were formerly considered sufficiently accurate for the traveller in unexplored regions" Hence, in the first and larger volume, which is as before, wholly devoted to surveying and mapping, some of the approximate methods, and the tables connected with them, have been omitted, and a higher standard of accuracy is aimed at throughout While it seems possible that the effect may be to discourage some travellers who could still do quite useful surveying work from attempting anything at all, and in others to transform a journey in an unexplored region into a surveying expedition pure and simple, it remains unquestionable that Mr Reeves has produced a condensed treatise on surveying of a high order of excellence

In the section on instruments, the chief new features are the descriptions of the applications of Mr Reeves's devices, the "tangent-micrometer" and "endless tangent screw," to the theodolite and sextant It may be noted that the illustrations of the transit theodolite on pp 29 and 40 are distinctly inferior to those in the older editions, and are scarcely sufficiently clear for their purpose Part iv of this volume, on geographical surveying and mapping has been practically re-written, the main heads dealt with are —(*a*) the determination of fixed points, which includes triangulation with the transit theodolite, latitude and azimuth traverses with normals of angles from stations on the route, and latitudes and longitudes, (*b*) the filling in of detail and route surveying, and (*c*) the determination of heights The first of these sections contains much new and useful matter relating to interpolation reduction to centre and geodetic computations The fifth division, on astronomical observations, has also been to a great extent re-written, the methods of determining longitude by means of lunars, moon-culminating stars, and the eclipses of Jupiter's satellites are omitted, and the space devoted to more complete descriptions of the observations for latitude, time and azimuth great additional clearness being gained in the computations by the free use of diagrams and formulæ The only absolute method of determining longitude described is that of occultations

In the second volume the chief new feature is an extremely valuable section on archæology, by Mr D G Hogarth which gives general hints on methods of recording, cleaning, temporarily conserving, and conveying monuments and objects of antiquity

Sechs Vorträge über das thermodynamische Potential, &c By J J van Laar Pp viii+119 (Brunswick Vieweg und Sohn, 1906) Price 3.50 marks

THIS pamphlet of close upon 120 pages really contains eight lectures, the first and second being as stated in the expanded title, on non-dilute solutions and osmotic pressure respectively These two introductory lectures are polemical, and attack in a lively manner the position assumed explicitly by some implicitly by many, that the so-called osmotic pressure is a real pressure due to the molecules of the solute The author pokes fun at the "dilute school" for pinning their faith to the first term of a diverging series, and for leaving out of account in all their theorising that most essential thing in osmosis the semi-permeable membrane He shows that instead of the "osmotic pressure' depending on the solute it depends fundamentally on the solvent, being mathematically expressible to a first approximation in terms of the difference of the molecular potentials of the two solutions separated by the membrane He makes an appeal in favour of the use of the thermodynamic potential, which is applicable to all cases, including those of weak solutions for which alone the method of the osmotic pressure is of any real service According to his facetious comparison, to explain the accompanying phenomena by an appeal to osmotic pressure is as if one explained an angry man's hasty speech as due to his red face The anger is the cause of both, and in like manner the thermodynamic potential forms the basis of the true theory Then follow the six lectures on the thermodynamic potential and its applications to the problems of chemical equilibrium

Lecture i begins with entropy, deduces the usual thermodynamic relations, and finishes with the general conditions for equilibrium The next lecture contains some simple illustrations leading to the recognition of particular cases of Gibbs's phase rule This important rule is proved in lecture iii, and more complex cases are considered of mixtures of solids liquids, and vapours The fourth lecture discusses the thermodynamic properties of mixtures of ideal gases deduces Gibbs's dissociation formula, and applies it to certain simple cases The effects of

temperature and pressure changes are also considered and the usual formulæ deduced Then follows, in lecture v, the investigation to a first approximation of mixtures of two fluids, leading to the discussion of fusion and solubility curves Finally, in lecture vi, vaporisation curves and the theory of the galvanic cell fall to be considered The same fundamental method is used throughout, the thermodynamic potential being first formulated, and then by differentiation the quantity known as the molecular potential Detailed examples elucidate the method, and there is no doubt that (to paraphrase his own words) the author has demonstrated, not only the great use of the thermodynamic potential, but also the ease with which it can be manipulated Dr van Laar has placed in the hands of the student of thermodynamics a well-written and serviceable pamphlet

The Family By Helen Bosanquet Pp vii+344 (London Macmillan and Co, Ltd, 1906) Price 8s 6d net

THE "Family" is a subject of far greater extent than most persons may think Its importance to society is enormous, though, like the air we breathe, it attracts little attention The variety in the constitution of family life in different places and at different times is extraordinary Its peculiarity in any given case is the result of many influences including long-standing tradition, economic causes, natural instincts, and legislation on succession of property The author has given a valuable *résumé* of facts and opinions derived from more than thirty writers of note, and she has blended them into a pleasant and readable volume which will open out new and wide vistas of interest to most of those who study it She says that the history of the Family "is a great work waiting for a great scholar" It is no disparagement to this book to add that she speaks truly, only it seems to the writer of this notice that a still more important requisite than scholarship is a more enlightened statistical treatment of the subject than it has for the most part yet received

One of the many of these desiderata is an exact analysis of the effects of different forms of the Family on the eventual well-being of the race These have a strong influence on the marriages or on the celibacy of its members The influence of the Family inclusive of religion, in France, is such that in the year 1900 as stated, no less than sixty-four thousand women were immured for life within convent walls Some forms of family life may be found to exert a considerable eugenic effect on the nation, others the contrary, how far has yet to be investigated In the view of the author the power of the Family is not decaying in England She thinks it has developed in a changed direction, through replacing a slavish submission to the head of the family by feelings of willing loyalty The proved habit of the artisan class to contribute to the well-being of the Family is to her an evidence of the strength of the bonds that still unite its members In conclusion, it should be said that this volume contains occasional passages of rare eloquence, such as those in p 160 and onwards, on the very real and spiritual entity of the Family F G

The Evolution of Man a Popular Scientific Study By Ernst Haeckel Translated from the fifth (enlarged) edition by Joseph McCabe Two vols in one Pp xiv+364 (London Watts and Co, 1906) Price 2s net

A TRANSLATION of the fifth edition of Haeckel's famous book is now procurable for two shillings! It is true that the text has been somewhat condensed, and that the beautiful plates of the complete edition have had to be omitted, but the gist of the matter is here, and is illustrated by more than four hundred figures Moreover, a library edition of the complete work is also available to English readers As is well known, the first half of the book contains a general account of the development of vertebrates, and of man in particular, while the second half discusses the chief phyletic stages from protists to man, and the gradually increasing differentiation of the various organs and systems There is a great deal of embryology and comparative anatomy in the book, but there is very little ætiology, and the English title "The Evolution of Man" is rather misleading The original title was "Anthropogenie" Many parts of the book, *e g* those dealing with the development of the fœtal membranes and of the excretory system, are very technical and difficult, serious students of biology will find these intricate subjects more clearly discussed elsewhere, and we do not think that other readers will understand them The translation bristles with mistakes, some of which show that even the translator has not always understood his text The kind of mistake we allude to is translating "Rest der Chorda" as "rest of the chorda," and "Zungenbogen" as "hyaloid bone"

Untravelled England By James John Hissey Pp xviii+459 (London Macmillan and Co, Ltd, 1906) Price 16s

THE author describes how he set forth in search of unfrequented spots in his own country and goes on to provide a pleasing and quietly entertaining account of the out-of-the-way places he visited The start from Eastbourne in a motor car does not, it must be confessed, encourage the reader to expect much in the way of romance, but the motor car, because of its persistently satisfactory conduct does not obtrude itself into the narrative There is no attempt at "fine" writing, yet the author succeeds in maintaining the reader's interest in the English and Welsh villages passed through and in conveying a pleasing impression of the characters of the natives encountered The volume is illustrated by twenty-four half-tone reproductions from photographs taken by Mr Hissey on the journey

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

A Japanese Singing Kettle

THE town of Morioka is well known for the manufacture of the iron kettle which is indispensable in every Japanese household There exist numerous forms of kettle several dozen shapes may be counted in a single shop but the most frequently occurring forms are cylindrical, pear shaped, and spherical The kettle is used for boiling water by means of charcoal fire for making tea On approaching boiling point some of these kettles begin to sing with quavering sound, which is a combination of different notes peculiar to the form and size of the kettle

There are several arrangements for producing sound, of which the following will indicate the manner in which the vibrations are produced Inside the kettle the bottom is nearly flat On this four pieces of sheet iron, 15 mm sq and 0 4 mm thick, are glued by means of Japan lac (*urushi*), which can well withstand the temperature of boiling water Between the bottom and the plates is an air space nearly ½ mm thick The plates are nearly in a plane and almost touch each other, leaving thin slits between them When the kettle is full the cell is under the water, and some air remains in the cell between the

plates, but as it is the part strongly heated by the fire the cell is filled with steam, which escapes in bubbles through the slits; the water then creeps into the cell, to be converted immediately into steam This process goes on at first intermittently, but it soon reaches a stationary state The bubbling of steam through the slits acts as exciter, and the kettle emits sonorous notes, which may be likened to the ruffling of pine trees by a gentle breeze or the sound produced by stridulating insects The difference of sound is mainly due to the form of the kettle rather than to the method of exciting the vibration To make the kettle sing loudly it is necessary to regulate the fire in such a way that the expulsion of steam bubbles from the cell is in good accord with the natural period of vibration of the kettle, so that it is set in sympathetic vibration Excessive heating is, therefore, unfavourable to singing

Various forms of steam exciter can be easily designed, and different manufacturers seem to have their own speciality When and where this method of exciting the vibration came into use is not well known, but as the kettles were common for many centuries, the exciter seems to have been invented by the amateurs of teaism (*chanoyu*) long before Western science was introduced to Japan

H NAGAOKA

Science College, Tokyo September 27

Bursaries at the Royal College of Science, London

SCIENCE scholars selected from the whole of Great Britain for their ability and promise, maintaining themselves on 17s 9d per week are year by year saved from much privation by secret gifts of small bursaries—see the subjoined audited account for last year

I have no right to ask for help from the generous men who helped me last year but I have all the sturdiness of a chartered beggar I ask in a good cause

It was originally intended that these bursaries should be given only to such National Scholars as required assistance, but some of the subscribers have given me power to assist other students of the college Also one of the two City companies has given me power to grant an occasional bursary of more than 10l It is understood that every student is morally bound to repay this money to the fund at some future time

JOHN PERRY

November 12

ROYAL COLLEGE OF SCIENCE

BALANCE SHEET, BURSARIES, 1905–6

Moneys Received and Paid by Prof Perry from July 12, 1905, to July 12, 1906

Received

	£	s	d
July 12, 1905—Balance in hand	22	19	0
,, ,, ,, —Royalty on Slide Rules	1	4	0
Oct 20, ,, — ,, ,, ,,	2	11	0
Nov 6, ,, —Dr Sprague	20	0	0
,, 13, ,, —A T Simmons, Esq	10	0	0
,, 16, ,, —Oscar Guttman, Esq	1	1	0
,, 21, ,, —The Drapers' Company	100	0	0
Dec 4, ,, —Robert Kaye Gray	10	0	0
,, 7, ,, —Matthew W Gray	10	10	0
Jan. 13, 1906—George Beilby, Esq	10	10	0
,, 13, ,, —Royalty on Slide Rules	3	15	0
,, 16, ,, —The Goldsmiths' Company	100	0	0
July 6, ,, —Royalty on Slide Rules	1	1	0
	£293	11	0

Paid

	£	s	d
July 12 to Dec 20, 1905—			
One Bursary	7	0	0
Two Half Bursaries, each £7 10s	15	0	0
Twenty three Half Bursaries, each £5	115	0	0
April 6 to June 15, 1906—			
Two Half Bursaries, each £7 10s	15	0	0
Twenty Half Bursaries, each £5	100	0	0
Balance	41	11	0
	£293	11	0

Audited and signed by

July 17, 1906 WILLIAM A TILDEN

LAKE BALATON [1]

LAKE BALATON, the largest lake in the Hungarian Plain, occupies a basin of internal drainage at the level of 343 feet above the sea, and has an area of some 230 square miles It is well known from the watering-places and mineral springs upon its shores In 1891 the Hungarian Geographical Society appointed a commission to undertake a detailed investigation of the lake The scheme was supported financially by the Hungarian Minister of Agriculture, the Hungarian Academy of Sciences, and Dr Andor von Semsey The results are being published in three volumes, the first deals with the geography, geology, hydrography, climate, and the physical and chemical characters of the lake water The second volume is devoted to biology, the third to the anthropography, ethnography, archæology bibliography, and the description of the watering-places There is also an atlas Several sections of the work and the topographic atlas have been issued They contain contributions to all three volumes, and illustrate the thorough nature and wide range of the work

The report on the ethnography by the late Dr Johann Jankó, translated by Dr Willibald Semayer is the longest contribution and is perhaps of most general interest It begins with a concise geographical description of all the localities around the shores of the lake, and then gives an interesting discussion of the place-names They are mainly Magyar, with some Sclav and German additions The place-names are classified into groups, based on orographic and hydrographic conditions on plants on the general features of the vegetation on animals on soils and rocks, on echoes (as in Ekko and Zongo odal, "the resounding side"), on industries, ecclesiastical terms, family and personal names, and races (English occurs in the term Angol Zollok, the "English vineyard" and in other names associated with gardens) Other places are named after the days of the week military terms numerals and unnatural death (such as 'Olo" for murder) Historical place-names are placed as a special group and they can be traced back to between the eleventh and fifteenth centuries, they are regarded by Dr Jankó as of especial historical value as showing the unbroken continuity of the Magyar occupation of the Balaton district during the past nine centuries in spite of the invasions of Tartars and Turks The old families who have been domiciled round Lake Balaton for at least a century are mostly Hungarians, 6 5 per cent are Jews, and 1 per cent are foreigners The census of 1890, enumerating a population of 55 000 gave their numerical proportions as follows -98 809

[1] 'Resultate der Wissenschaftlichen Erforschung des Balatonsees Balatonsee Commission der Ung Geographischen Gesellschaft (Vienna Ed Holzel 1902–1906)

Vol i 'Physische Geographie des Balatonsees und seiner Umgebung Part iv, Sect 3 Resultate der Phytophänologischen Beobachtungen in der Umgebung des Balatonsees By Dr Moriz Staub completed by Dr J Bernatsky 45 pp, 1 map (1906) Part v Die Physikalischen Verhältnisse des Wassers des Balatonsees Sect 2 and 3, Die Farbenerscheinungen des Balatonsees, by Dr E von Cholnoky, Die Reflexionserscheinungen an Bewegten Wasserflächen, by Dr Baron Bela Harkanyi 88 pp, 2 col plates (1906.)

Vol ii 'Die Biologie des Balatonsees.' Part i, Die Fauna des Balatonsees Beiträge zur Kenntniss des Planktons by Dr Geza Entz, Jun and i and ii Nachtrag zur Aufzählung der Weichthiere, by Dr A Weiss and Theodor Kormos 76 pp (1906) Part ii, Die Flora Sect 1 Die Bacillarien des Balatonsees, by Dr Josef Pantocsek 112 pp, 17 plates (1902)

Vol iii 'Social und Anthropogeographie des Balatonsees Part i Archæologie der Balatonsee Umgebung Sect 1, Archæologische Spuren aus der Urzeit und dem Altertum bei Veszprem By Gyula Rhe 33 pp 2 col plates (1906) Part ii Ethnographie der Umwohner des Balaton gestades By the late Dr Johann Jankó, continued by Dr Willibald Semayer 499 pp, 1 map (1906) Part v Bibliographie des Balatonsees By Julius von Sziklay 65 pp (1906)

Spezialkarte der Balatonsees und seinen Umgebung By Dr Ludwig von Loczy 4 sheets. Scale 1 to 75,000. (1903)

per cent. Magyar 0·828 per cent. German 0·081 per cent. Croat 0·059 per cent. Slovak and 0·005 per cent. Wend.

The description of the daily life and industries of the inhabitants of the district of Balaton is of especial interest. Some of the people live in artificial caves dug out on the hill-sides in what from the photographs look like deposits of loess. Some of these cave dwellings are high up in the face of the cliff, and they are explained by Dr. Jankó as having been occupied when slopes led up to them and before denudation had cut back the ground and left the ends of the old excavations like hanging tunnels on the face of the cliff. The author figures the picturesque mud-walled thatched houses and the carved wooden furniture, and describes the industries, of which the most interesting is his account of the fishery. He describes the regulations of the Fishers' Guild and the methods of fishing from the fire-hollowed flat-sterned canoes (bottich schiffe), from sledges used on the ice in winter, and by the fish traps composed of labyrinthine fences.

Fig. 1.—Ancient Artificial Cave Dwellings in the District of Lake Balaton.

The archæology of Lake Balaton is described by Gyula Rhé. There are tools and flakes of the Stone age, numerous implements and pottery of the Bronze age, and well-preserved remains of a Roman settlement at Pogany-telek.

The three sections of the first volume deal with seasonal plant distribution and with the physical characters of the lake water. The work on phenology was begun by Dr. Moriz Staub and continued by Dr. Bernatsky; extensive observations on the time of blooming of *Galanthus nivalis*, *Corylus avellana* and *Cornus mas* have been used to map out the part of Hungary between the Danube and the Drave into seven zones characterised by the earliness or lateness of the vegetation.

The investigation of the physical characters of the lake water has been conducted by Dr. von Cholnoky and Baron Harkanyi. The former has determined the transparency of the water under different conditions of wind and season, and its essential colour, which varies from the highest to the middle numbers (11–6) in Forel's scale. He also discusses the influence of movements of the water on its colour, and the complex colour and light effects produced by wind and ripples. The sky has an especially powerful effect on the colour, as the lake is in open plains with low banks, but different colours are seen under the same sky conditions, and they are explained as polarisation effects. The apparent uplift of hills by mirage is illustrated by a telephotograph and by a series of views showing the different elevation of distant hills under varying conditions of refraction. The discussion of the colour effects is illustrated by excellent sketches showing colour effects on the shores of the lake under different climatic conditions, and is followed by an investigation by Baron Harkanyi on reflection effects from moving water.

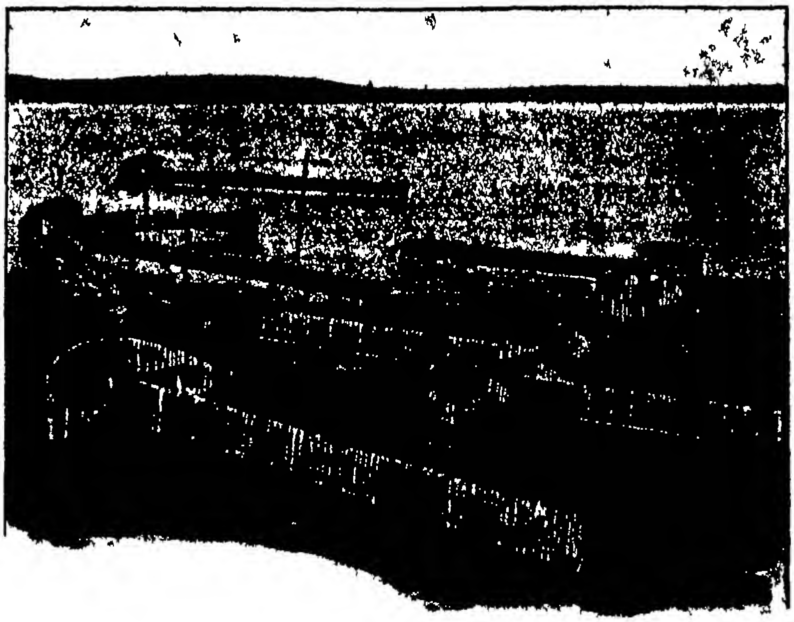

Fig. 2.—Fish Traps on Lake Balaton.

The reports on the biological sections of the work are represented by two sections. A monograph of the diatoms by Dr. Josef Pantocsek gives a systematic account of the 288 species, many of which are new. The Mollusca are catalogued by Dr. Weiss and Theodor Kormos. Dr. Weiss's list raises the number

of known species in the fauna to 106. Contributions to the knowledge of the plankton are given by Dr. Geza Entz; he describes twenty-three species of Peridiniaceæ, and figures the seasonal variations of *Ceratium hirundinella*, which lives in the lake throughout the year, and is common from May to November.

The last part of the whole work, the bibliography, has been compiled by Dr. Julius von Sziklay. It enumerates all the independent works, with summaries of their contents, and has special sections for maps and for contributions in journals and serials.

The Hungarian Geographical Society is to be congratulated on this valuable contribution to natural science. The monograph on Lake Balaton will be of value to all students of the natural history and geography of Central Europe, and its summary of modern methods of research will be of use to students of lakes elsewhere. Moreover, the description of the country, revealing the quiet charm of its scenery and the many interests in the life of its people, should lead more visitors to this attractive district.

A 100-INCH REFLECTING TELESCOPE.

As time passes and astronomical work advances there is a greater demand, year by year, for more powerful instruments of research. Fortunately, instrument makers have so far been able to fulfil the requirements for large refractors and reflectors, but a few years ago the time seemed to be reached when further progress appeared a long distance off. At the present day there are refractors in existence the object-glasses of which are as large as 30, 36, and 40 inches in diameter, while the greatest glass mirror that has been used measures 60 inches in diameter.

In the case of the largest refractor, namely, that erected in the Yerkes Observatory in America, it seems possible that the size of this form of telescope has nearly reached its limit. The reasons for this are that, not only is it extremely difficult and costly to cast and figure lenses of such dimensions, which to give the best definition must be practically flawless, but the mounting has to be so immense and strong, and consequently very expensive in proportion.

It must be remembered that in the refracting form of telescope the object-glass has to be placed at the *upper* end of a long tube, while the observer takes his place at the lower end; these ends have to be very rigidly connected together, and the whole tube mounted so as to be capable of being moved in any direction. Thus in the case of the Yerkes telescope the tube had to be 62 feet long (weighing six tons), and the whole mass of metal that required moving every time the telescope was required in a different position was twenty tons. This will give some notion of the engineering difficulties that are involved in large refractors. In reflectors, on the other hand, the mirror is placed at the *lower* end of a comparatively light tube, and as close as possible to the mounting on which it is carried. In fact, in the case of the late Dr. Common's 5-feet reflector a means was adopted of actually floating the mirror.

In considering, therefore, the construction of telescopes much larger than those that already exist attention is naturally being paid more to the reflecting type than to refractors. Further, it is not necessary that the glass casting for a mirror should be so perfect as that required for an object-glass, for in the former case only a perfect reflecting *surface* is required, while in the latter the light has to pass through the whole mass of glass. It is obvious, then, that much larger discs of glass can be made which may be suitable for reflectors but useless for refractors. Aperture for aperture, a mirror costs about one-tenth the price of an object-glass, and this gives some idea of the extra work and risk involved in producing a good object-glass.

The expense attached to the mounting of a reflector is also considerably less than that of refractors when large instruments are in question.

Now not only is the reflector the less expensive of the two forms of instruments, but it has many distinct advantages optically. Thus chromatic aberration is a thing unknown in reflectors. Again, light being totally reflected from the silvered surface of a mirror is not lost like it is in refractors, where it always has to pass through the object-glass, and is consequently partially absorbed.

Mirrors are, however, easily tarnished and affected by changes of temperature, but these disadvantages do not counterbalance the many points in their favour, to which reference has been made, when exceedingly large instruments are under consideration.

In the Proceedings of the American Philosophical Society (vol. xlv., No. 182, p. 44, 1906) Prof. E. C. Pickering communicated a paper entitled "An International Southern Telescope," and in it he strongly advocated the erection of a large telescope of the reflector type. His proposal was that the telescope should have a diameter of about 84 inches and should be set up in some locality such as South America or South Africa, where the observing conditions are considered very favourable. Towards the end of the paper Prof. Pickering referred to the important work that could be accomplished by means of such a large reflector, and mentioned that the name of a donor "could in no way be better immortalised than by associating it with such a real advance in the greatest problem to the solution of which the mind of man has aspired—the study of the sidereal universe."

We learn now from the current number of the *Astrophysical Journal* (vol. xxiv., No. 3, October) that Mr. John D. Hooker, of Los Angeles, who on former occasions has rendered financial assistance to astronomy, has presented to the Carnegie Institution of Washington the sum of forty-five thousand dollars to purchase a glass disc 100 inches in diameter, 13 inches thick, and 50 feet focal length, and to meet other expenses incident to its construction. These latter will include the erection of a building in which the mirror can be ground, figured, and tested, the construction of a large grinding machine, with crane for lifting the mirror ($4\frac{1}{2}$ tons); the provision of a 54-inch glass disc to be made into a plane mirror for testing purposes, and other necessary items.

The large mirror is intended for use at the Solar Observatory of the Carnegie Institution situated on Mount Wilson, in California, and under the directorship of Prof. G. E. Hale. This observatory has already a 60-inch mirror in its optical shop, and at the present moment it is being tested. In the case of the new 100-inch reflector, we are told the St. Gobain Company expresses its deliberate opinion that such a disc, 13 inches thick, can be produced and that the Company will be able to carry out the order which has been given to it.

The grinding and figuring will be entrusted to Prof. G. W. Ritchey, and no unsurmountable difficulty is anticipated by him in bringing such a mirror to a high order of perfection. The 60-inch mirror now nearly completed, is the largest he has yet attempted, and this is now nearly ready for mounting.

At present no financial provision has been made for the mounting and housing of this 100-inch reflector, but as the mirror will take, as we are told, about four years to complete there is no immediate hurry.

The experience gained by the form of mounting adopted for the 60-inch mirror will be valuable when the time comes for the erection of the 100-inch mirror, and funds will no doubt soon be found when the right moment arrives

Already the United States is the possessor of the two largest refractors and silver-on-glass reflectors This new monster will afford her another means of greatly extending astronomical knowledge, which has made such vast strides during the last decade owing to these increased aids to observation

AN EXPERIMENT IN INSECT-EXTERMINATION [1]

IN the year 1900 the sugar-cane planters of Hawaii were seriously alarmed by the appearance in considerable numbers in their plantations of an introduced hemipterous insect allied to the cicadas and commonly known as the cane leaf-hopper, but designated scientifically *Perkinsiella saccharicida* Since that date the pest has increased to an enormous extent, with an estimated loss of many millions of dollars to the planters Fortunately, the leaf-hopper has a certain number of enemies among the insects indigenous to Hawaii, since had it not been for the extent to which it was held in check by their attacks it seems probable that sugar-growing would by this time have become absolutely impossible in the islands

These indigenous enemies were, however, utterly unable to cope in a thoroughly efficient manner with the swarms of the leaf hopper, and it became apparent that unless some other means of diminishing its numbers were discovered the sugar industry of the Sandwich Islands would be practically ruined Accordingly, the officials of the Entomological Division of the Planters' Association at Honolulu set to work with commendable energy and enthusiasm to endeavour to find an efficient and satisfactory remedy It appears to have been soon decided that such a remedy would most likely be discovered in the form of insects which would prey upon the leaf-hoppers with greater vigour than any Hawaiian species, and in 1903 and the two following years expeditions were organised to North America Australia, and Fiji with the view of discovering such insects

In due course a number of species inimical to the cane leaf-hopper were brought to light, and the present elaborate bulletin (of which one part has been already briefly noticed in our columns) is devoted to the description and life-history of leaf-hoppers and their enemies, together with an account of the experiments which have been made in introducing and acclimatising certain of the latter into Hawaii

The list of insects parasitic on leaf-hoppers is a very long one and comprises representatives of several orders, although the great majority belong to the Hymenoptera For our present purpose attention may be concentrated on the few species it has been found advisable to introduce into Hawaii In the case of the introduction of such parasites four points are essential —(1) Their effectiveness as destroyers of the pests, (2) the possibility of successful transportation, (3) the probability of their thriving in the new country, and (4) their rapidity of increase when introduced The choice was soon narrowed down to certain minute Hymenoptera which feed upon the eggs of leaf hoppers, namely, to species of Anagrus and Paranagrus in the family Myrmaridæ and to one of Ootetrastichus among the Eulophidæ The members of the two first genera complete their life-cycles in about three weeks, breed at about the same rate throughout the year, and are largely parthenogenetic Ootetrastichus, on the other hand, takes fully twice as long to complete its cycle, but produces twice as many eggs, and is wholly parthenogenetic. *Caeteris paribus*, the products of the myrmarids at the end of six months will, however, be a million times more numerous than those of the other genus On the other hand, the ootetrastid is not only more hardy, but has the advantage that each individual is bred at the expense of the whole contents of the egg-chamber of the leaf-hopper instead of destroying only a single egg

Of the four species introduced one of Paranagrus is at present the most effective, but the Ootetrastichus is slowly but surely increasing in numbers, and is eventually expected to prove the most effective For further details respecting these interesting and to a great extent even at present successful experiments, our readers must be referred to the Bulletin itself

R L

[1] "Leaf hoppers and their Natural Enemies Edited by R C L Perkins Bulletin No 1 of the Experiment Station of the Hawaiian Sugar Planters Association Honolulu 1905–06 10 parts Pp xxxii + 490, illustrated

THE FLIGHT PROBLEM

THE real "flights" not "jumps," which Mr Santos Dumont has been making at Paris with his new aeroplane have directed the attention of the whole aeronautical and motor world in the direction of the problem of flight Further, tempting prizes have now been offered which will undoubtedly stir up other workers to take up the problem and so increase the chance of rapidly advancing the progress of aerial navigation

In addition to the Archdeacon prize of 200*l* for a half-mile course and to the enterprising offer of the *Matin* of 4000*l*, which was subsequently increased to 10,000*l* by public subscription for the first traveller who succeeds in covering the distance between Paris and London in 1908, the *Daily Mail* has now come forward with the offer, open to the world, of 10,000*l* to the first person who shall fly by aeroplane from London to Manchester in twenty-four hours, including two stops to take in supplies of petrol

Such large prizes will certainly go a long way towards giving a strong impetus to the manufacture of aeroplanes and also to the motor industries to produce the lightest forms of petrol engines In fact, a great number of people will almost immediately set about experimenting with aeroplanes in order to compete for the prizes We read that already Mr Santos Dumont has given an order for a lighter and more powerful engine, namely, a 100 horse-power motor which will weigh no more than 200 lbs

Since Mr Santos Dumont's successes were announced, several references have been made to the experiments which have been carried out by the brothers Wright in America, but very little is known about their results, since they have purposely avoided publicity, according to the views of Sir Hiram Maxim, as stated in the *Daily Mail*, they have a new motor to their aeroplane which is twice as effective as their previous one, and they hope to "fly with it 200 to 300 miles without stopping"

Up to the present time there has not been any great inducement for workers to come forward and demonstrate publicly the capabilities claimed for their machines The rewards now offered will no doubt serve as an incentive to them, and possibly others, to enter the arena and prove in open competition the efficiency of their designs

NOTES

THE meetings for the discussion of important contributions to meteorological literature, arranged by the director of the Meteorological Office, will be resumed on Monday, November 26, at 5 p.m., with a discussion of Mr. J. Aitken's paper "On Dew."

A REUTER message from Toronto records that on November 19 electrical energy generated at Niagara Falls, eighty miles away, was delivered there for the first time. A supply of 40,000 horse-power is available.

CAPTAIN AMUNDSEN, the leader of the *Gjoa* Polar Expedition, and his companions arrived at Christiania on November 20. Among the large number of people who assembled on the landing stage to receive the explorer were the President of the Storthing, the members of the Government, and the magistracy, the President of the Municipal Council, the admirals of the station, the general in command of the capital, and the president of the Norwegian Geographical Society.

ON November 13, at 11 p.m., a sharp shock of earthquake was felt both in the south and the north of Jamaica. It was immediately followed by a second shock, the heaviest experienced in Kingston for many years. From Perth, Western Australia, it is reported that an earthquake was felt at 3.20 p.m. on November 19 along the whole of the coast from Albany to Sharks Bay. The shock was very severe at Perth, Busselton, Geraldton, and Marble Bar.

THE spermatogenesis of one of the swallow-tailed butterflies (*Papilio rutulus*) forms the subject of a long article by Dr. J. P. Munson in the Proceedings of the Boston (U.S.A.) Society of Natural History (vol. xxxiii., part iii.).

IN the *Irish Naturalist* for November Mr. R. J. Ussher gives an account of the excavation of certain "hyæna-dens" in the Mammoth Cave near Doneraile, county Cork. The discovery of the system of caves of which this forms a part is recorded in the Proceedings of the Royal Irish Academy for November, 1904. Seventy-six baskets of bones and teeth were obtained from the Mammoth Cave and dispatched to the Dublin Museum. All the remains identified appear referable to the ordinary cavern species, but the remains of the cave hyæna are the first record of the occurrence of that species in Ireland.

Two articles are included in vol. lxxxiv., part iv., of the *Zeitschrift für wissenschaftliche Zoologie*, one by Mr. F. Hempelmann on the morphology of two marine annelids of the genus Polygordius, and the second by Dr. E. Zander on the filtering apparatus of the gills of teleostean fishes. In 1903 the latter author discovered a certain appendage to the gill-filters of fresh-water fishes, and the present paper is based on a fuller study of this structure, more especially in marine species, of which a large number has been examined. It has been found that the development, and in some degree also the function, of the filtering apparatus vary considerably according to the mode of life, bottom-dwelling species using it to aid in the supply of nutriment.

AN interesting article on entomological photography appears in *Focus* of November 21. The object of the article is to show how photographs of many kinds of insects may be taken in all stages of their existence from living specimens in captivity, and in some instances amid imitations of their natural surroundings. When aquatic insects form the subject of the experiment, a narrow and deep tank is, of course, essential. When dealing with butterflies, it is found most advantageous to take them just after leaving the chrysalis, or, failing this, they may be made quiescent by the application of a small quantity of chloroform. The photograph of a group of five "tortoise-shells" appears very successful. In the case of night-flying moths, it is impossible to display the full characters of the species from living specimens when at rest, while to depict them flying is likewise an impossibility. To overcome these difficulties the photographer has resorted to the plan of first photographing mounted specimens in the positions desired, and then combining the photograph thus obtained with one of a suitable background. If a suitable landscape-negative has been previously taken, by placing this behind the focusing screen the moths can be arranged in such a position that they will appear exactly in the right place in the compound picture.

IN the course of a paper on the papillary ridges and papillary layer of the skin of the hand and foot of mammals other than man, published in vol. xli., part i., of the *Journal of Anatomy and Physiology*, Dr. Walter Kidd points out that these structures attain their maximum development in the lemurs and their relatives. "These characters suggest very clearly that in this group of animals the sense of touch is extremely important. . . . If one bears in mind that three [groups] of them are nocturnal and arboreal and the other two diurnal and arboreal, one can gather from these facts the great importance to them that their sense of touch should be very acute. A continual need of their arboreal lives is that they should maintain by reflex means their equilibrium, and I would suggest that in their highly developed papillary ridges and papillary layer of the corium they possess most efficient structures for the transmission of impulses to their nerve-centres for the performance of this important function." To the same issue Mr. E. J. Evatt contributes a paper on the development of these structures. The other articles are mainly devoted to the description of various monstrosities and other abnormalities.

IN the Proceedings of the American Academy for October there is an interesting study of inheritance in fishes by Mr. A. P. Larrabee. In the majority of the teleosts the fibres of the two optic nerves do not interlace at the chiasma, but remain distinct, and it has been shown for certain species that specimens in which the nerve running to the right eye is dorsal, and specimens in which the reverse is the case, are almost equally frequent. The present investigation, commenced by Dr. W. E. Castle and completed by Mr. Larrabee under his direction, was undertaken with the view of determining whether this character is heritable, and if so in what manner. Crossings were made with the brook trout and with the cod, and the rather remarkable conclusion is reached that the character is not inherited at all. Of 971 trout, for instance, in both the parents of which the right nerve was dorsal, 52 per cent. had the right nerve dorsal, while of 1519 with unlike parents 56 per cent. had the right nerve dorsal. The character does not appear to be affected by gravity, the dimorphism is not due to an earlier development of one of the optic nerves, and in monstrous two-headed specimens of the trout the two heads differ in structure as often as not. Practically speaking, it seems to be a matter of chance which nerve is dorsal. There is, however, a curiously persistent preponderance of cases with the right nerve dorsal, and Dr. Castle in a footnote directs attention to the apparent similarity of the phenomenon with the more frequent occurrence of polydactylism in guinea-pigs on the left side of the body.

IN the first part of vol. xxxvi. of Gegenbaur's *Morphologisches Jahrbuch* Prof. Schmaltz, of Berlin, furnishes

further information with regard to the assertion (mentioned some months ago in these columns) that a pleural cavity is lacking in the Indian elephant. The author's observations are based on dissections of four elephants, one from the Berlin Zoological Gardens and three from a circus. In each instance the structure of the pleural viscera was of the same type. The heart was normal. The lungs possessed a dense fibrous capsule, but between their outer surface and the wall of the thorax occurred a homogeneous mass of connective tissue, completely filling the cavity of the chest. The connective tissue presented no signs of being a pathological product, and, in the author's opinion, it must consequently be accepted as a fact that a pleural cavity is absent in the Indian elephant. In a second article Mr. A. Rauber records and figures two instances of the occurrence of an "intermetatarsal bone" in the foot of the human subject. The bone in question is an ossicle wedged in between the entocuneiform of the tarsus and the bases of the first and second metatarsals. The number of recorded cases of a similar abnormality is now brought up to eighty-eight, and the author concludes by discussing the bearing of this feature on the theory of a lost digit. The contents of the same issue also include an article, by Dr. C. Gruber, on the structure and development of the reproductive organs of the guinea-pig; a second, by Dr. W. Braun, on the development of the pancreas in the midwife-toad; and a third, by Mr. Max Borchert, on the central nervous system of the torpedo.

THE *Philippine Journal of Science* for September (i., No. 7) contains a long paper on beri-beri by Mr. M. Herzog, who believes that this disease is an infective one, the organism of which has yet to be discovered; notes on Philippine and other birds, by Mr. R. C. McGregor; and a description of a new genus and species of Culicidæ, by Mr. C. S. Banks. This mosquito (*Worcesteria grata*) does not bite, and its larvæ destroy numbers of noxious forms of Culicidæ. The genus is near the genera Megarhinus and Toxorhynchites. The number is well illustrated with many plates, and is a most creditable production.

IN the Bulletin of the Johns Hopkins Hospital for November (xvii., No. 188) Dr. C. W. Eliot discusses the future of the medical profession, and concludes that in the course of time it will have the satisfaction, not only of ameliorating the condition or prolonging the life of the suffering individual, but also of exterminating or closely limiting preventable diseases. Notes on the International Congress of Tuberculosis, Paris, 1905, are contributed by Dr. H. B. Jacobs, and on the advantages of local sanatoria in the treatment of consumption by Dr. D. R. Lyman. Governor John Winthrop, jun., of Connecticut, a physician of the seventeenth century, is the subject of a paper by Dr. W. R. Steiner, and Prof. Welch's address on the unity of the medical sciences, delivered at the dedication of the new buildings of the Harvard Medical School, is published in full.

THE issue of selected papers on rubber from the *Kew Bulletin* as No. 7 of the additional series is opportune at the time when this product is receiving so much attention. Not only do the papers furnish a historical account of the gradual accumulation of knowledge that is bearing fruit at the present day, but old facts served up as new, such as the artificial production of rubber, are here placed in proper perspective. The most recent papers are the synopses of the genera Kickxia and Funtumia, by Dr. O. Stapf, published in the *Kew Bulletin*, 1905, and a note on the rise and fall in prices of Para rubber contributed by Mr. J. H. Hillier to the part lately issued.

A CATALOGUE of botanical slides issued by Mr. A. Peniston, Montpelier Terrace, Leeds, can be recommended to the notice of those desiring microscopical slides of practical educational value, illustrating the chief features in the taxonomy and anatomy of plants. Of the slides examined, the root apices showing mitoses and the transverse section of Equisetum root were especially good, and all were satisfactory. Messrs. Clarke and Page, of London, supply botanical and geological preparations, but make a greater speciality of marine slides, which, judging from specimens seen, will be found suitably and well prepared.

THE annual report for 1905 of the Royal Botanic Gardens, Ceylon, contains eight reports by assistants, in addition to the general report by the director, Dr. J. C. Willis. The branch gardens at Badulla and Anuradhapura were closed in favour of a botanic garden at Mahailuppalama, where an experiment station has already been established. Rubber has, of course, monopolised most attention, but the production of the oils of cocoa-nut, citronella and cinnamon shows a considerable increase, and in the market for coca leaves Ceylon provides the standard. The curator of the Peradeniya gardens records the failure of the attempt to propagate Hevea by cuttings; as a substitute for boxwood edgings in tropical gardens he recommends cuttings of *Malpighia coccifera*.

THERE are several facts and observations, interesting to botanists, on the subject of xerophytes and plant transpiration in the publication No. 50 of the Carnegie Institute of Washington entitled "The Relation of Desert Plants to Soil Moisture and to Evaporation," representing investigations by Dr. B. E. Livingston at Tucson, in Arizona. With regard to the soil, it was found that the deeper layers contained an adequate supply of water even at the end of the dry season, this being due partly to the formation of a dust mulch. Cacti showed no greater osmotic pressure in the cell-sap than plants in humid regions. An ingenious evaporimeter, consisting of a porous clay cylinder attached to a burette and water receiver, was devised for comparing evaporation with transpiration. The author expresses the opinion that air temperature, and not light, is the main controlling factor in the rate of transpiration.

PROF. POTONIÉ, of Berlin, contributed a paper (an abstract of which has now reached us) to Section K at the York meeting of the British Association, in which he pointed out the strict parallelism that exists between the different kinds of peat and the different kinds of coal (which is simply fossil peat). When conditions are such that organic remains collect under terrestrial conditions we have ordinary peat formed. This corresponds exactly with "bright" coal. When, on the other hand, organic remains collect under water, the result is an organic slime which the author calls "sapropel," becoming of a gelatinous consistency ("saprokoll") when subfossilised. This, according to Prof. Potonié, is exactly equivalent to the "dull coal" or "cannel coal" of Carboniferous age. When terrestrial and aquatic conditions have alternated during the accumulation of organic remains, we obtain "strata-peat" or "strata-coal," i.e. interbedded saprokoll and peat, or "bright" and "dull" coal. The chemical and physical properties of these varieties correspond very closely, the cannel coal being gas coal and saprokoll containing much more gas than genuine peat. The author regretted that living peat bogs were so extensively killed

by drainage, and pointed out that we were thus destroying a possible source of fuel supplies when our coal should be exhausted.

THE Channel tunnel project forms the subject of an article in the *Engineer* (vol cii, No 2654) Particulars are given of what has been accomplished, from an engineering and scientific point of view, upon the other side of the Channel towards the solution of the great international problem

AT the Institution of Civil Engineers on November 13 a paper was read on single-phase electric traction by Mr C F Jenkin A paper on electric traction on railways, by Messrs Mordey and Jenkin, was read before the institution in 1902 The object of the present paper was first to bring the previous account of the different systems up to date, and to show how far the conclusions then arrived at have to be modified in the light of recent experience, and then to describe the equipment required for single-phase working and to discuss the different problems which arise in connection with it Little advance has been made in continuous-current working The voltages have risen a little, and in a few cases pressures of 1000 and 3000 volts are in use The principal advances in three-phase working have been the completion of the Zossen experiments, the opening of the Valtellina line, and the adoption of three-phase working for the Simplon Tunnel Experience has confirmed Messrs Mordey and Jenkin's conclusion that the single-phase is the only system which can satisfy all the requirements of a general system

ACCORDING to the official statistics published in the Mines and Quarries General Report (part iii, 1906) the output of coal in Great Britain in 1905 was the highest hitherto recorded, being as much as 236,128 936 tons Of this total, 47,476,707 tons were exported, and 19,255,555 tons were used in the manufacture of pig iron The home consumption was 3 91 tons per head of population Statistics relating to the manufacture of coke and briquettes were collected for the first time, the production of coke in 1905 having been 18,037,985 tons, and that of briquettes 1,219,586 tons There were 31,060 coke ovens in operation Of these, 25,514 were of the beehive type, and there were 2233 Coppée ovens, 726 Simon-Carvés ovens, 503 Otto-Hilgenstock ovens, 470 Semet-Solvay ovens, 72 Koppers ovens, 52 Bauer ovens, and 1490 other kinds The production of iron ore was 14,590,703 tons, which yielded nearly one-half of the total quantity of pig-iron (9 608,086 tons) made in the country Copper, lead, silver, and tin show an increase on the figures of 1904, both in the amount and in the value of the metal obtained

A SIMPLIFIED method of transforming readings of the Fahrenheit thermometer into centigrade values and *vice versâ* is given by Dr Hellmann in No 38 of the *Naturwissenschaftliche Rundschau* The ordinary formulæ, for example $C=5/9(F-32)$, are not adapted for rapid calculation. The modified formulæ

$$C=(\tfrac{1}{2}-\tfrac{1}{2}\cdot\tfrac{1}{10}-\tfrac{1}{2}\cdot\tfrac{1}{100})(F-32), \text{ and } F=(2-\tfrac{2}{10})C+32,$$

on the other hand, containing decimal fractions, lend themselves much more readily to the purpose To transform, for example, 110° F, we have 110−32=78, and the centigrade value becomes 39+3 9+0 4=43° 3

A REVISION of the atomic weight of bromine made by Mr Gregory P Baxter in the chemical laboratory of Harvard College is published in the Proceedings of the American Academy of Arts and Sciences (vol xlii, No 11) Considerable uncertainty exists as to the purity of the materials employed in several of the earlier determinations, owing principally to the fact that while it is easy to eliminate metallic impurities from silver, it is not so easy to ensure the absence of occluded gas Two different methods were adopted in the determinations in one, highly purified silver was converted into silver bromide, in the other, the ratio of silver bromide to silver chloride was determined by acting on the former with purified chlorine As many different methods of purification as possible were employed for the materials used Eighteen determinations by the first method gave a value of the atomic weight varying from 79 950 to 79 955, silver being taken as 107 930, thirteen determinations by the second method ranged from 79 951 to 79 955 The average of both series was 79 953

A VOLUME of essays, or rather lectures, by the late Lieut -General A. Lane-Fox Pitt-Rivers, edited by Mr J L Myres, will be issued immediately by the Oxford University Press Mr Henry Balfour, the curator of the Pitt-Rivers Museum, has written an introduction to the volume, which is entitled "The Evolution of Culture"

THE eleventh volume of the complete works of Christiaan Huygens, which are being published from time to time by the Société Hollandaise des Sciences, is in course of preparation and will, it is expected, be ready in about a year The tenth volume of the works was reviewed in our issue for August 17 1905 (vol lxxii, p 362) Meanwhile, an extract from the eleventh volume has been issued separately under the title "Travaux divers de Jeunesse, 1645–1646" it is edited by M D J Korteweg and published by M Nijhoff, of the Hague Several papers written by Huygens in 1645 and 1646—that is to say in his seventeenth and eighteenth years—are included in this preliminary publication

MESSRS WILLIAMS AND NORGATE have sent us a prospectus of "The Paintings of Antiquity" edited by Herr Paul Herrmann, and published by Herr F Bruckmann, of Munich The work is to be published in sixty parts and will contain about 600 plates, of which twelve to fifteen will be coloured Six parts will be published annually The nucleus of the collection of pictures is formed by reproductions of wall paintings removed from their original positions in houses at Pompeii, Herculaneum and Stabiæ, and taken to the Museo Nazionale at Naples A limited selection of mosaics will be included Whatever paintings have been preserved of the ancient Greek and pre Hellenic periods will be comprised in the collection and the work will also include the most important of the mummy portraits from the Fayûm

OUR ASTRONOMICAL COLUMN

ANOTHER NEW COMET (1906*h*) —A telegram from the Kiel Centralstelle announces the discovery of a comet on November 14 by Mr Joel Metcalf of Taunton (Mass) Its position on that date at 10h 04m (Taunton M T) was R A =4h 6m, dec =2° 16′ S, and the apparent direction of its motion is given as south-west This position is about half-way between 35 and ξ Eridani, and crosses our meridian shortly after midnight The comet's magnitude is given as 12 0

A second telegram states that this object was observed by Mr Hammond at Washington on November 16, its position at 11h 38m (Washington M T) being

R A =4h 4m 11 4s, dec =2° 46′ 55″ S,

and its magnitude 11 0

COMET 1906*g* —From observations made on November 10, 11, and 12, Herr M Ebell has calculated a set of elements and an ephemeris for comet 1906*g* the discovery of which was announced in these columns last week The elements show that this comet passed through perihelion on November 7

Ephemeris 12h Berlin

1906	α (true) h m s	δ (true) ° ′	1906	α (true) h m s	δ (true) ° ′
Nov 20	10 0 55	24 28.1	Nov 28	10 41 34	34 10.6
24	10 20 51	29 24.7	Dec 2	11 2 57	38 38.5

The brightness of this object is now decreasing, and will be 1.04 times that at the time of discovery on November 24, when its magnitude was 8.5 (Kiel Circular No. 92). In announcing the discovery of this comet last week it was stated that the magnitude was not given in the Kiel telegrams. Prof. Kreutz writes to point out that the magnitude was given, and we regret that the group of figures containing it was mistranscribed whilst decodifying the message.

HALLEY'S COMET.—In vol. cxv., part v., of the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Dr. J. Holetschek discusses the probable time at which Halley's comet may be looked for with reasonable chance of success during its forthcoming return. By reason of a particular combination of perturbations the present period of revolution ($74\frac{1}{2}$ years) is the shortest observed since 1531, but after determining the comet's distance from the earth and the sun during the oppositions of 1906–9, Dr. Holetschek concludes that there is no great likelihood of this object being re-discovered before the latter part of 1908. At the end of 1909 it should certainly be easily observable, and during the second half of March 1910 it should become a naked-eye object. According to the elements published in the *Connaissance des Temps* (1900) the comet is due to pass through perihelion on May 16, 1910.

A BRIGHT METEOR.—An exceptionally beautiful meteor was observed by Mr. Rolston at the Solar Physics Observatory, South Kensington, at 13h. 26.5m. on November 17. The approximate positions of the beginning and end of the trail were $\alpha = 75\frac{1}{2}°$, $\delta = +24°$ and $\alpha = 88°$, $\delta = +14°$ respectively. The narrow fan-shaped head was nearly as bright as Jupiter, and left behind it a shimmering trail of a reddish colour, similar in appearance to the shower of sparks which come from a suddenly-braked train wheel. The duration of the meteor's flight was little more than one second, and the trail died away immediately.

THE UNITED STATES NAVAL OBSERVATORY PUBLICATIONS.—We have received from the U.S. Naval Department a copy of part iv., vol. iv. (second series), of their Publications, containing, in addition to a profusely illustrated account of the 1900 and 1901 eclipse expeditions, previously described by Dr. W. J. S. Lockyer (NATURE, vol. lxxiii., p. 486, March 22, 1906), a number of tables for use in the reduction of astronomical observations. The reduction tables for transit-circle observations contained in part ii. are only suitable for the Naval Observatory, with the exception of the refraction tables, which are based on the Pulkowa values.

Part iii. contains reduction tables for equatorial observations, including those for differential refraction and instrumental corrections. In part iv. there is a very interesting discussion of the present status of the use of standard time, in which a fairly complete account of the standard times in use in every part of the earth is given.

The conversion tables and the summaries of the time in each country giving the standard meridians and the relation to the standard times of other countries should prove very useful for reference purposes.

THE ACTION OF TRAM-CAR BRAKES.

THAT steep gradients can be overcome by mechanically propelled tram-cars—as compared to ordinary railway trains—and that street-cars are driven on public thoroughfares more or less crowded with other traffic, renders the brake question one of considerable importance. The lamentable accident that occurred at Highgate last June affords strong evidence of this. On June 23 a double-deck bogie car became unmanageable and ran at a great pace for a distance of about three furlongs down the hill extending southwards from Highgate Archway to the Archway Tavern. The gradients here though considerable are not excessive for tramway work when the cars are operated with due care. The lines have an inclination of about 1 in $22\frac{1}{2}$ on the hill, but in other parts of the line the gradient is 1 in 18, whilst gradients of 1 in 9 have been authorised. Colonel Yorke, to whose full and admirable report on the accident we shall make frequent reference, has said that the Board of Trade insists on track brakes being fitted to all cars running over gradients of 1 in 15, the speed being limited to six miles an hour. Of the passengers on the car, only a few were slightly injured, but three persons in the street were killed and twenty were injured, some seriously. The runaway car collided with a hearse, a furniture van, a motor-omnibus, and another van, being finally brought to rest by a stationary car at the terminus. The chief lesson to be gained from the disaster is connected with the action of brakes on vehicles of this description.

The car would carry thirty passengers inside and thirty-eight on the top. It was of the double-bogie type with eight chilled cast-iron wheels and maximum-traction trucks, the small wheels leading. There was a 35-h.p. motor on each bogie truck, the motors being geared to the axles of the large driving wheels. The general design appears, from the descriptions given in Colonel Yorke's report, to be of a well-known type in which the effort is made to get the maximum weight for adhesion on the driving wheels without the use of a motor on each axle, the latter being an arrangement which, with a double-bogie car, would need four motors. With this design the distribution of weight becomes a matter of great importance. The car in question weighed twelve tons unladen, and the engineer to the owners, the Metropolitan Electric Tramway Company, has estimated that four tons were carried upon each of the driving axles, and two tons upon each of the pony axles.

The car had hand brakes, of the usual description, working brake blocks on all eight wheels, and was also fitted with electromagnetic track brakes having two shoes on each bogie. There were also four sand-boxes operated from the driving platform.

The track brake has been introduced at a comparatively recent date, and is especially for tramway work. Its failure to stop the car in the instance under consideration is therefore a circumstance worthy of close inquiry. There are two leading descriptions of electromagnetic track brake or slipper brake, but Colonel Yorke's report does not specify the type fitted, although the description fairly well indicates which was used. There are certain features common to both types, and each acts by the brake shoes being strongly attracted to and pressed on the rails by magnetic force. The magnets formed by the brake shoes are energised by current generated by the car motors. Colonel Yorke gives a concise description of the brakes on the car under notice. Each brake shoe consisted of two narrow steel plates 15 inches long, placed side by side, with a small interval between them, thus forming the poles of a powerful electromagnet excited by current supplied by the motors acting as generators. The shoes of the brakes in question were also connected to the brake blocks which formed part of the hand brakes, so that the latter pressed against the wheels, and therefore automatically came into play when the track brakes were applied. This is a usual arrangement. With electromagnetic brakes of this description there is a retarding action due to the motors running as generators, and therefore putting a braking action directly on the axles. It will be understood that the hand brakes can be operated without putting the magnetic brake in action. Resistances are provided between the motors and the magnets so as to regulate the current in the latter. In this way magnetic adhesion can be controlled at will. It is further claimed that an advantageous effect is produced by the pressure on the rails by the wheels, due to the attraction of the magnets. The electromagnetic brake clearly supplies a most important means for checking the speed of a car. Colonel Yorke describes it as "one of the most modern, and, when properly used, one of the most effective devices for controlling tram-cars."

The car had been recently overhauled, and was apparently in good condition. New brake blocks had been fitted to the driving wheels, the clearance being 1/16th of an inch when off. The driver stated that one of the sanders was

not in good condition, but there appears to have been some doubt on this point, in fact, the balance of evidence is that the driver was mistaken. The driver also stated that he had had trouble with his hand brakes previously to the accident, the wheels, he said, seemed to skid directly the brakes were applied, and, when released, did not immediately revolve even when sand was used.

It was a regulation of the company that all cars should be brought to rest at the top of the hill, but when the driver attempted to stop his car with the hand brake the wheels skidded, owing, as he said, to the rails being greasy from having been recently watered. Upon this he released the hand brake and tried the magnetic brake, but as the wheels continued to revolve the magnetic brake was useless, and the result was that the car ran past the Archway without stopping, and came on to the gradient of 1 in 22. The speed having increased so that the car was getting beyond control, the driver signalled to the conductor to apply his hand brake, but this having no effect the conductor released it again. The driver then reversed his motor, thus causing the automatic switch to blow, after which he moved the controller handle to the position in which the motors would generate current against each other in order to produce a powerful braking action. These efforts, however, had little effect on the speed of the car, which dashed down the hill with the terrible results before mentioned, until brought to rest by running into the empty car at the bottom of the hill. Before this the driver had jumped off, abandoning the car to its fate, his desertion being more disastrous as there was no one to ring the bell, a circumstance which in Colonel Yorke's opinion, led to the large number of persons being injured. The fact seems to suggest the need of an automatic continuous striking bell which would be put in operation only upon emergencies. This would have the additional advantage of relieving the driver of one operation at times when he would be hard pressed.

It will be gathered from what has been said that the electromagnetic brake is only brought into play when the motors are acting as generators, and therefore it evidently cannot be used when current is being supplied to the motors from the overhead conductor. The motors become generators through the action of the road wheels, and, therefore as soon as the latter cease to revolve the current required to energise the brake magnets ceases to be generated. This is the weak point of the arrangement, for if the hand brakes are put too hard on the wheels will skid or be locked, and the rail brake become useless. The loss of the assistance of the magnetic brake owing to the skidding of the wheels is more serious because the fact of skidding reduces very greatly the retarding effect of brakes upon a car.

The experiments made in 1878 on the Brighton Railway by Sir Douglas (then Captain) Galton, Mr. Stroudley, and Mr. Westinghouse are fairly well known to railway engineers. Apparatus was designed by Mr. Westinghouse by means of which, through water pressure and Richards indicators, there were recorded the retarding force which the friction of brake blocks exerted on wheels, the force with which the blocks pressed against wheels, and the force required to drag the van. These experiments clearly proved that when the wheels of a car are skidded, or blocked by the brakes, the retarding effect is very much less than when the brake shoes are pressed on the wheels with a force just short of that needed to cause skidding. The fact was known previously, indeed, in 1846 Mr. J. V. Gooch issued an order to the men on the South-Western Railway that wheels were not to be skidded, and the result might have been deduced from the experiments of Prof. Fleeming Jenkin on the effect of friction.

Although a skidded wheel does not afford the same resistance to the forward movement of the car as does one which continues to revolve, yet the brake shoes must be pressed on to the wheel with sufficient force to produce an effective braking action. This action is by far the most effective just at the instant that skidding commences, there being then a very sudden rise in tangential resistance. Just at the moment the brakes are released—the wheels being skidded—there is another rise in tangential force caused by the brake blocks. Prof. Fleeming Jenkin's experiments on the effect of friction at different speeds may be consulted with advantage in connection with these results. Although the ordinary brakesman does not carry out quantitative experiments by the aid of elaborate apparatus, he finds by experience that his brakes are most effective when the critical point is approached. The most skilled men will manipulate their brakes with great effect, getting the greatest retarding action for the car without skidding the wheels. The best way in which to work brakes, therefore, is to apply a considerable force at first, releasing it as the skidding point is almost reached.

Another point in connection with brake action, which almost follows from what has been said, is that although a good deal of pressure on the blocks is needed to make a wheel skid, a comparatively moderate force is needed to keep the blocks on when the wheels have once stopped revolving. Still another point bearing on the question under consideration is the decrease of friction that takes place with increase of speed of movement between rail and wheel. This is contrary to what is observed with lubricated surfaces but, as Sir Alexander Kennedy has pointed out, it bears out the smaller experiments of Prof. Fleeming Jenkin. On the Brighton Railway Company's trials the effect was clearly proved. The experimental van was drawn alone by a powerful express engine and was thus able to maintain a high speed with the brake on, and it was clearly shown that there was greater adhesion between rails and skidded wheels at high speeds than at low speeds. In some cases the tangential force diagrams showed a rise in adhesion of 100 per cent.

The bearing of these facts on the present case is plain. That a driver of a car will go as near skidding as possible is apparent, and an unskilled man will often pass the critical point. Then the wheels will cease to revolve and no current will be generated to energise the electromagnet, consequently the rail brake will be out of action, and, as a skidded wheel does very little to check the momentum of the car, all the elements of a serious catastrophe are present when descending any considerable incline. Beyond this the rail brake cannot hold a car stationary on a hill when once it has been brought to rest.

These defects would be overcome if the main current from the overhead conductor were available for energising the electromagnet. This would introduce some complication and extra fittings, but there does not appear to be any insuperable difficulty. The fact that the present electric-rail brake is liable to fail just when it is most needed—as shown by the Highgate tragedy—and the remembrance of the terrible results of a heavy car rushing down uncontrolled amongst traffic, make it plain that considerable sacrifice is warranted if the powerful rail brake can be brought more readily into play at a time when it is most efficient, namely, before the travel of the car has acquired a high velocity.

The particulars we have already of the accident form a practical illustration of the bearing of the experimental data collected on the Brighton Railway trials. Whether the skidding of the wheels of the car—which undoubtedly took place, as flats were afterwards found on the tread of the wheels—was due to want of skill on the part of the driver or to injudicious rigging of the brake is a matter of interest rather than importance, for drivers are as liable to be flurried or unskilful as brakes are likely to be improperly rigged. In regard to the first proposition, the driver's training in the present case consisted of eleven lessons of about one hour each in a school and twelve lessons on the road. This appears to have been considered sufficient instruction to entitle the driver to hold a certificate of "thoroughly instructed in the duties of a motor-man and now competent to take charge of a car." After that he had three days' practice on the Archway route with another motor man, including one day's instruction with the motor brake. He had been in regular work for twenty days at the time of the accident.

We are not aware whether this driver had had any mechanical training, or had been employed about the mechanism of motor vehicles before he began his driving career, but if not the course of instruction appears insufficient. This was borne out by his evidence at the inquest, for he was not aware that the magnetic brake

acted independently of the current from the trolley-wire, a fact quite sufficient to account for him attempting to apply the magnetic brake when the wheels were skidded In regard to the hypothesis that the accident was due to improper fitting of the hand brakes, Colonel Yorke says that the shoes, which cleared the wheels 1/16th of an inch, as stated, were new and of cast-iron The rubbing surface would therefore have the rough skin characteristic of iron castings, and friction would be greater than when the blocks had been worn smooth by use A very slight pressure would cause the wheels to skid, and as the springs which pull the brake off had only 1/16th inch compression, the brake might remain on after the driver had moved the brake lever to the release position The position of the brake blocks, in regard to the vertical component, may also have had an effect in keeping them on, as Colonel Yorke points out in his report The blocks were hung so that they would be below the centre of the wheels, and therefore the upward movement of the periphery of one wheel in each pair would tend to force the brake on when once it had made contact Colonel Yorke very properly condemns this arrangement, as it prevents the brakeman from using any nice adjustment such as is needed to prevent the wheel from skidding Sir Douglas Galton, in his paper before the Institution of Mechanical Engineers, recommends half an inch clearance between the wheels of a railway coach and the brake blocks, and it is usual in railway practice to place the blocks level with the wheel centres, or somewhat higher The nice adjustment of control needed for working hand brakes efficiently especially when rails are greasy, and therefore easily skidded is hardly possible with brake rigging such as was used The transmission was by a chain wound upon a spindle and through a series of rods and levers, "often roughly shaped to size and length in a forge, and connected by ill-fitting pins and joints, or by short lengths of chain" as the Board of Trade report states It is easy to understand that lost motion, due to such rigging, would account for a good deal of lag even if the gear were new

AN EDUCATIONAL GAP[1]

FOR many years past the attention of those who have been giving serious consideration to the complex educational problems which arise in this country has been directed to the gap which exists between the time at which pupils ordinarily leave the public elementary schools and that at which a very small proportion of them appear as students at our technical institutions and at various evening classes Many attempts have been made to bridge over this gap by continuation classes of various kinds and under various conditions, but these attempts cannot be said to have been successful in the past to any extent commensurate either with the importance of the problem or with the amount of care which has been bestowed upon it The causes of failure are deeply rooted in our social and economic organisation, whether we consider the large towns, the country districts, or the intermediate districts which are partly urban and partly rural In the large towns for instance, as soon as a lad is released from compulsory attendance at school, either by age or by the attainment of the necessary standard, his services have a market value which his parents are usually very unwilling to forego, though its immediate sacrifice may have an important effect upon the ultimate success of the youth in after life The consequence is that especially in London, large numbers of these boys take positions as van boys, errand boys and in similar occupations, in which for a few years they can earn wages up to or exceeding 10s per week By the time, however, that they reach the age of eighteen or nineteen they cease to be eligible for such work, and, not having utilised the intervening years since leaving school in attaining expertness in any skilled occupation there is no other course open to them but to join the ranks of unskilled labour, whence the step to those of the unemployed and unemployable is easy, especially, as they have reached the age at which their parents can no longer be expected to contribute to their maintenance In the country, other causes lead to somewhat similar final results

The inquiry of the consultative committee deals in great detail with one series of suggestions and experiments for bridging this gap for a minority of the pupils referred to. The particular problem minutely examined is that of providing slightly "extended facilities" (in a secular sense) for the best pupils, who would otherwise leave the elementary schools at the usual age of fourteen years or earlier, and whose parents would be subjected to the temptations mentioned above The question inquired into is how best to establish a type of school capable of educating such children, the parents being willing to maintain them for the necessary time, to a somewhat higher standard without trenching on the proper province of the secondary schools, on the one hand, or of the training which prepares specifically for a definite career on the other

The problem is one well suited for the consideration of the consultative committee on account of the wide and varied educational experience of its different members. To strengthen its hands, and to obtain the necessary information which might not be available within the four corners of its own membership, it has examined a carefully selected number of representative official and non-official witnesses, twenty-five in all For obvious reasons the names of the official witnesses are withheld, and therefore no names whatever are given nor is the evidence published in full, but ample quotations are made from it wherever they are deemed necessary and relevant to support the arguments of the report The only criticism one has to make upon the selection of the witnesses is that so few as five employers of labour can scarcely have had sufficiently varied individual experience to supply materials for dealing with so large a problem

That the present is a time of transition and experiment, and that the points of view from which educational problems are being attacked are rapidly changing, could receive no greater exemplification than is conveyed by this report The gradual change of the official attitude towards such problems has been very apparent to outside observers during the last four or five years in the different reports, prefatory notes to codes, and other official publications issued by the Board of Education from time to time This report deals in full detail with numerous points brought into view by the new standpoints, and it is to be hoped that the conclusions of the committee on these and cognate matters may be fully adopted by the Board in shaping its policy, without, however, rushing into opposite extremes

The swing of the pendulum from the time when "payment by results" was the fashionable official system has indeed been great and every page of this report bears evidence of the distance which has been travelled from those "dark ages" In point of time, however, the period referred to is sufficiently close to have left a legacy, which forms a factor in the present problem, in the shape of a body of teachers some of whom still find it difficult to realise that they are "freed from the trammels they have been accustomed to all their lives," and who have "a certain stock-in-trade which they think can be used anywhere"

The chief value of the report consists in the recognition, and some of the consequences of that recognition, of the proper function of education, in the root sense of the word, as a training of the moral qualities, the formation of habits of mind being regarded as more important than the acquirement of mere knowledge Prominence is given to the importance of the development of self-activity and resource, and powers of observation, the fostering of intelligence and interest in the work, and that training of the eye and the hand in conjunction with the brain which leads to "general handiness" These are some of the points dwelt upon, not once or twice, but many times and in varied aspects, in the pages of the report

The report also puts its finger upon some of the most glaring defects of the present and previous systems of education, both elementary and secondary The results, which have long been painfully evident to those who in any form have been entrusted with the further education of the pupils turned out, are that these pupils have not

[1] Report of the Consultative Committee upon Questions affecting Higher Elementary Schools. (Adopted by the Committee May 24, 1906, and issued, with a Prefatory Note, by the Board of Education, July 20, 1906.)

been taught "how to learn," that they are deficient in resource, in self-help, in curiosity of the right kind. In the majority of cases they are quite incapable of thinking for themselves, and in a large number of cases they cannot express their ideas, if they have any, in simple English. Such consequences necessarily follow from the old bad system of "payment by results" in the elementary schools, and from obsolete and defective methods of teaching, coupled with the worship of examinations, in the secondary schools.

The type of school proposed for filling the "gap," under whatever name it may be known, is one which aims at taking the best children of the elementary schools sufficiently early in their career to enable them to reach a somewhat higher standard of attainment than is aimed at in the elementary schools themselves. For good reasons which are set forth in the report, the age at which the change from the elementary school should be made is considered by the committee to be not less than twelve years. At this age the best pupils of the schools, selected by some simple qualifying examination combined with reports from the head teachers, are to be drafted into the new type of school. In this school the length of the course is to be three years, so that the pupils should remain there until they are fifteen years old. To ensure this it is felt that the parents of all pupils so transferred should be put under a moral obligation to maintain them at the school until the completion of the period, though it is recognised that it is not practicable to make the obligation a binding one in the legal sense.

The curriculum in the new type of school will differ within certain limits according to the needs of the locality in which it is placed, being different for (a) country districts, (b) the smaller towns of 20 000 to 50 000 inhabitants, and (c) large towns. Whilst specialised instruction such as is proper to the technical institute or the trade school is excluded, the aim of the school, in whichever of the above environments it may be placed, is to prepare the pupils more thoroughly for their life-work. Speaking generally, the curriculum is to consist (1) of what are usually classed as humanistic subjects, (2) of scientific and mathematical subjects, and (3) of manual instruction, with some physical training. In the humanistic section the English language and literature is to form the basis of the instruction, it being recognised that it is not possible to teach a foreign language effectively under the conditions, and Latin is of course excluded. History and geography are taken as subdivisions of the main subject. Class singing and religious instruction come under the same section, to which, on the whole, about one-third of the teaching time is to be devoted. In the scientific and mathematical subjects are included arithmetic, algebra and the principles of geometry, all as applied to practical calculations, account keeping as distinct from book-keeping, graphical methods of calculation, mensuration, and elementary natural science, with experimental work done by the pupils and varied according to the environment. To this group of subjects another third of the time is to be given. The manual instruction includes, for boys, general wood and metal work, treated from an educative standpoint, and aiming at the training of hand, eye, and brain, in addition there is definite instruction in drawing of the non professional kind, machine drawing, for instance, being excluded. For girls this manual instruction is replaced by training in domestic subjects and housecraft. Finally, about two hours per week are to be devoted regularly to physical training, which, of course, will differ not only as between boys and girls, but also in different localities.

One great difficulty in carrying out this scheme is that of obtaining the right kind of teachers. It is insisted upon more than once that what is important is the method of teaching rather than the matter. The ideal teacher, it is pointed out, should be a man of character and ability, with freshness of mind, thoroughly alive to the environment and thoroughly sympathetic with his pupils, he should be quite free from the old trammels which grew up in the dark ages referred to above. In which it will be remembered that the teacher who wished to rise to the higher posts in his profession was encouraged to pile certificate upon certificate in a great variety of subjects, in few, if any, of which, as results showed, was he really qualified to teach. Suggestions are made as to the training of these teachers, some of which appear to the writer not to be very practicable, more especially the suggestion that the teachers should spend one year in actual workshops. Apart from the difficulty of getting employers to be bothered with such men in their factories, the writer is of opinion that the year could be far more profitably employed in other directions, as the smattering obtained by so short an experience and so limited a view of commercial life is apt to be more harmful than useful. It is important to notice that the report emphatically recognises that for special technical subjects special teachers are required, but then these subjects are ruled out of the curriculum of the schools under consideration and, indeed, such subjects as shorthand, machine drawing, book-keeping, industrial chemistry and typewriting, some of which even modern schoolmasters are often inclined to view with favour, are set aside as unsuitable in any scheme of general education, whether secondary or elementary.

Considerations of space will not allow us to dwell upon many other important matters of detail which are handled in a masterly manner in this valuable report, suffice it to say in conclusion that it will well repay careful study, and certainly ought to be perused by everyone who is interested in the rapid developments which are taking place in the educational world.

R. M. W.

ELECTRIC TRAMWAYS

THE leading feature of the current issue (No. 180, vol. xxxvii.) of the Journal of the Institution of Electrical Engineers is the paper on the overhead equipment of tramways by Messrs. R. N. Tweedy and H. Dudgeon, especially in view of the fact that the overhead system has been so abused of late years by the general public, and thousands of pounds sunk in other schemes of electric tramways which might have been enormously reduced if the prejudice which exists against the overhead system on account of its supposed "danger" had been removed. The authors throughout the paper make a strong appeal for more economy in the capital outlay of tramway equipment, and show how in their opinion this may be brought about in the case of the overhead system.

Dealing with the size of pole to be employed, the authors are strongly of the opinion that we err seriously on the side of using too heavy and too strong poles, straining them too much, and consequently having larger span wire and more concrete for fixing than is necessary. Also they would do away with the usual cast-iron bases which protect the poles, as being not only a waste of money—being unnecessary—but also an actual source of danger, in that they prevent the pole within them from being painted when the outer portions are done—unless the box is lifted, a costly process—and allow water to accumulate inside the case, which causes the pole to rust badly.

The same remarks apply to the collars which it is customary to place round the joints in the poles, and water is liable to do much damage here also. If the bases are not done away with they must be ventilated and drained, so as to prevent the accumulation of water from sweating. The collars also must be drained properly. More economy is to be brought about in the trolley-wire itself, as in the authors' opinion too large a section is now being used, and they think that from 50*l.* to 80*l.* per mile may be saved on this charge alone. Again referring to the "hangers," the authors strike out strongly for the use of malleable iron in place of bronze and gun-metal fittings, which are so dear to some engineers—and are also dear in price as compared with malleable iron properly galvanised.

No local action takes place—with the malleable iron hanger—between the span wire and hanger as is the case with bronze hangers, and from experience iron hangers have been found to last longer than bronze or brass ones, though the oxidation of the iron bolts is one of the difficulties attendant on the overhead system. The authors suggest three methods of overcoming the difficulty:—

(a) The insertion of a shield between trolley-wire ear and the hanger to prevent the trolley wheels throwing

water up into the interior of the hanger—thus keeping the bolt dry—and "neither rust nor electrolysis can corrupt"

(b) A different form of hanger—simply a metallic link between the ear and span wire, and insulated by two or three independent external insulators

(c) The hanger to be composed of glazed porcelain with a plain metal bolt passing through, but the porcelain must be kept dry and sheltered from rain

Several other points of interest are touched upon by the authors, and the discussion which followed the reading of the paper by Mr Tweedy proved that the opinions on the points raised by the paper were very varied, and led to a keen criticism The idea of a shield was generally welcomed, and a suggestion was made that it should be manufactured in such a form as to be readily adjusted to existing hangers, without having to dismantle the same

On the subject of the strength of poles, however, the majority was against any reduction in size, and the question of the Standard Committee's "standard pole" provoked an animated discussion

The subject of the paper is one which for a long time has needed discussion, and the interest in it was shown by the fact that after the paper was read and discussed at the Birmingham local section's meeting it was re-discussed in London later in the session and we may hope that the many points and facts brought forward will help to mitigate the present existing difficulties of the overhead system, and at the same time help to reduce the capital expenditure on tramway schemes that may be undertaken by local authorities

SOME ASTRONOMICAL CONSEQUENCES OF THE PRESSURE OF LIGHT[1]

JUST a year ago Prof Nichols gave here an account of the beautiful experiment carried out by himself and Prof Hull which, with the similar experiment of Lebedew, proved conclusively that a beam of light presses against any surface upon which it falls Not only did Nichols and Hull detect the pressure which is difficult enough so minute is it, but they measured it with extraordinary accuracy, and confirmed fully Maxwell's calculation that the pressure on 1 sq cm is equal to the energy in 1 cubic centimetre of the beam

Thus we have a new force to be reckoned with It is apparently of negligible account in terrestrial affairs, partly in that it never has free and uninterrupted play But out in the solar system, where there is no disturbing atmosphere and where it may act without interruption for ages it may produce very considerable results Even here so minute is the force that it need only be taken into account with minute bodies Prof Nichols in his discourse told how it may possibly account for the formation of comets' tails if these tails are outbursts of finest dust To-night I shall try to show how it may be of importance with bodies which though still minute are yet far larger than the particles dealt with by Prof Nichols Such small bodies appear to abound in our system and to reveal their existence on any starlight night when perishing as shooting stars

We are to examine, then how the pressure of light or more generally the pressure of radiation, from one end of the infra red to the other end of the ultra violet spectrum will affect the motion of these small bodies

I think we get a clearer idea of the effects of light or radiation pressure if we realise from the beginning that a beam of light is a carrier of momentum that it bears with it a forward push ready to be imparted to any surface which it meets

Thus let a source A (Fig 1) send out a beam to a surface B, and to bring out this idea of carriage of momentum let A only send out light for a short time, so that the beam does not fill the whole space from A to B but only the length CD While the beam is between A and B B feels nothing But as soon as D reaches B B begins to be pushed, or it receives momentum in the direction AB and will continue to feel the push or receive momentum until C has reached B when the push will cease The existence of this push on B is definitely proved by the experiments of Lebedew and Nichols and Hull Now, unless we are prepared to abandon the conservation of momentum, this momentum must have existed in the beam CD and have been carried with it, and it must have been put into the beam by A while it was sending forth the waves A, then, was pouring out forward momentum, and was feeling a back push while it was radiating This back push against the source has not, I think, been proved to exist by direct experiment, though an indirect proof may perhaps be afforded by the case of reflection When a

FIG 1

beam is totally reflected, the push measured in light-pressure experiments is double that when it is absorbed, that is, there is a push by the incident beam and an equal push by the reflected beam and we may perhaps regard the reflected beam as starting from the reflector as source, and then we have a push back against the source But whether this be proof or not, I do not see how there can be the slightest doubt that the pressure against the source exists, and that for the same intensity of beam it is equal to that against a receiving surface

Some experiments which have been made by Dr Barlow

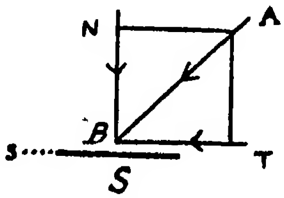

FIG 2

and myself appear to bring to the front this conception of light as a momentum carrier When a beam falls on a black surface it is absorbed—extinguished—and its momentum is given up to the surface In a beam of light AB (Fig 2) the momentum is a push forward in the direction AB, and if it falls on a black surface S it gives up this momentum to S The total push which is in the direction AB may be resolved into a normal push N and a tangential push T If S can move freely in its own plane, and only in that plane, T alone comes into play, and S will slide towards s

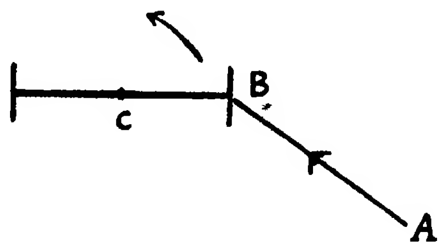

FIG 3

To show this effect we fixed two glass discs at the end of a short torsion rod hung by a fine quartz fibre the discs being perpendicular to the rod, and the face of one of them being blackened Fig 3 shows a plan of the arrangement The apparatus was enclosed in a glazed case, which was exhausted to about 2 cm pressure of mercury On directing a horizontal beam AB at 45° on to the black surface B the normal force merely pressed B back, but the tangential force turned B round the point of suspension C away from AB It is difficult to make the disc quite symmetrical and the beam quite uniform, and

[1] Discourse delivered at the Royal Institution on May 11, by Prof J H Poynting F R S

unless these conditions are fulfilled the disturbing forces due to heating of the surface, convection currents and radiometer effects may easily have a large moment either way round C. But these disturbing forces take time to develop, as Nichols and Hull showed, while the tangential push of the light acts instantly. Always when the beam is first directed on to B the motion in the first second or two is away from AB.

It has been urged that this experiment is not conclusive in that the lampblack is granular, and the force observed may be due to normal pressure against the sides of the grains. But if the back surface of the disc is blackened, so that the surface is much smoother, the action is as great.

Another form of the experiment which we have lately made is perhaps better. A horizontal disc of mica, about 2 inches in diameter, is suspended in the case by a quartz fibre (Fig. 4). The disc is blackened on its under face. If a beam of light AB is incident at 45° at B, it tends to push the disc one way round. The gas action due to heating may possibly and sometimes does, act against this push. But if an equal beam CB is sent from the other side instead of AB, the heating, and therefore the gas action, is the same, while the tangential push is in the opposite direction, and the deflection now is always less in the direction of the arrow than it was before, and the difference gives twice the effect due to the tangential push of either.

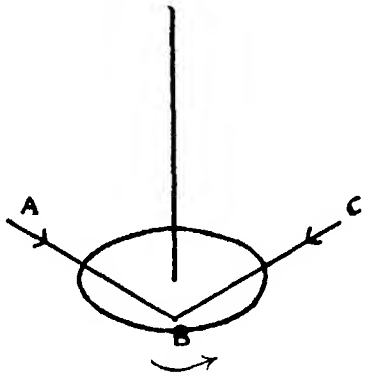

FIG. 4.

Another experiment, rather different in kind, even more clearly shows that light carries a stream of momentum.

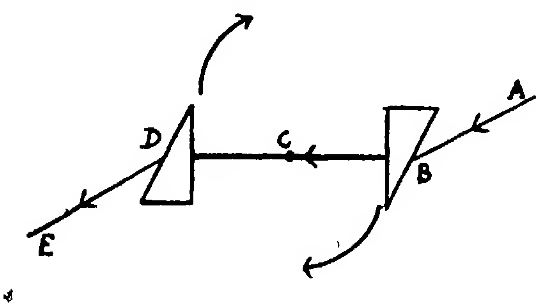

FIG. 5.

Two glass prisms BD (Fig. 5) were fixed at the end of a torsion arm and suspended by a fibre from C. A beam of light AB was directed horizontally so as to pass through the two prisms and emerge parallel to its original direction along DE. Always the torsion arm turned as indicated by the arrow, just as a pipe would tend to turn if it were bent as the beam of light is bent and carried a stream of water—a stream of forward momentum.

I will not now dwell on the interesting modification of the third law of motion which we must make to reconcile with it these experiments on light. It is enough to say that we must admit the luminiferous medium into momentum transactions just as long ago we admitted it into transactions with energy.

Let us now see how this way of regarding a beam of light leads us to expect a modification of the pressure when the receiving or the emitting surface is moving.

First, let us suppose that the receiving surface is moving towards the source. Let A (Fig. 6a) be the source. Let B be the receiving surface, moving towards A with velocity u. If B were at rest at C it would receive in one second the radiation and the momentum in length CD = U the velocity of light. But when a given wave starts from D, let the surface start from B and let them meet at the end of a second. Then B has evidently absorbed the momentum in length BD = U + u, and it has received more than it would have done if at rest in the ratio U+u : U. The pressure therefore is increased, and by the fraction u/U. It is easy to see from Fig. 6b that if B is moving away from the source it receives less momentum, has less pressure than if it were at rest, and the decrease is again by the fraction u/U. We may call this the "Doppler reception effect." "Doppler" since he was the first to point out the effect of motion on radiation.

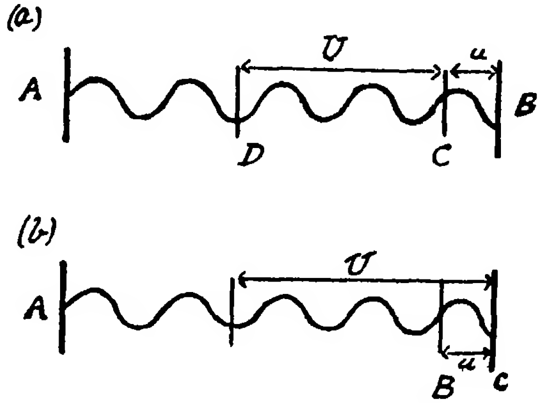

FIG. 6.

If the source is moving there is a nearly equal effect upon it. The pressure is increased if it advances and is decreased if it retreats, but the effect arises in a different way. It is now due to alteration of wave length. The source crowds up and shortens the waves it sends forward, putting into them more energy and more momentum, and so suffering an increase in pressure, while it draws away from and lengthens the waves it sends backward, putting into them less energy and momentum, and so suffering a decrease in pressure. The alteration of pitch produced in sound by motion of the source is familiar to all.

We can easily deduce the alteration in pressure if we make the reasonable assumption that the amplitude, the height or depth of the waves sent out from the source depends on its temperature alone, and not on its motion.

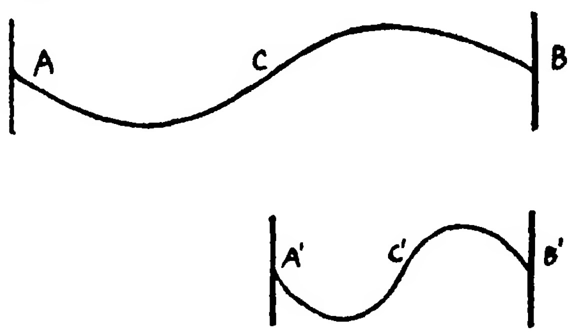

FIG. 7.

Let us imagine, by way of illustration, that the source moves with half the velocity of light, so that a wave which would be ACB (Fig. 7) is packed into half the space A'C'B'. With waves of the same height the energy in a

given length is inversely as the square of the wave length, so that A′C′B′ has four times the energy and momentum that ACB has *in the same length*, or the wave A′C′B′ has twice the energy and twice the momentum of the wave ACB sent out in the same time, and the pressure against A′ is twice that against A

When the speed of the source u is small compared with that of light, the increase of pressure in forward motion, or decrease in backward motion, is practically the fraction u/U (more exactly it is altered to $U/U \pm u$ of the value when at rest) We may call this the Doppler emission effect

Coming back to the pressure on a source at rest, that pressure depends on the rate at which the source is pouring out radiant energy, and that rate depends on the temperature of the source If the body is a black body or a full radiator, the rate of radiation is as the fourth power of the absolute temperature, a law no longer depending on precarious hypotheses, but the result of direct experiment Here is a table showing the energy radiated and the pressure back against the radiating surface at three important temperatures —

Radiation from and Back Pressure against a Radiating Surface

Absolute temperature	Energy emitted in ergs per second per sq cm	Back pressure in dynes per sq cm
0°	0	0
300° (Earth)	$4\ 3 \times 10^4$	$9\ 6 \times 10^{-6}$
6000° (Sun)	$6\ 9 \times 10^9$	1 5

A black surface on the earth, then, is pushed back with a force of 1/100 000 mgm per sq cm by its own radiation while the surface of the sun is pushed back with a force of a milligram and a half on the square centimetre This table helps us to realise the exceeding minuteness of the forces with which we have to deal

While we are considering the connection between radiation and temperature, it will be useful to see how the temperature of an absorbing particle depends on its distance from the sun Take first such a particle at the distance of the earth from the sun If the sky were completely filled with suns it would be at the temperature of the sun and give out the corresponding radiation But the sun only fills 1/200,000 of its sky, so that the particle only receives and gives out 1/200,000 of that radiation Its temperature is therefore $\sqrt[4]{200,000}$, say about twenty times less than that of the sun We can form a tolerably good estimate of the temperature of the particle since the rotation of the earth and its circulating atmosphere make its mean temperature, which is nearly 300° absolute, the same as that of the particle So that the temperature of the sun is probably about 6000° absolute or at any rate gives out as much radiation as a full radiator at that temperature

If we move the particle in to, say, one quarter the distance, a little within the nearest approach of Mercury, the heat from the sun is sixteen times as great, so that the temperature of the particle is twice as great, say 600° absolute, about the temperature of boiling quicksilver Out near Jupiter it will be half as great say 150° absolute, the temperature varying inversely as the square root of the distance

Now we have the data from which we can trace some of the consequences of light pressure in the solar system

The direct pressure of sunlight is virtually a lessening of the sun's gravitation for, like it, it varies as the inverse square of the distance As we can by direct measurement find, or at any rate form an estimate of the energy per c c in sunlight, we can calculate the pressure which sunlight exerts on a square centimetre exposed directly to it at the earth's distance, and it works out to about 0 6 mgm per square metre On the whole earth it is only about 75 000 tons, a mere nothing compared with the sun's pull, which is forty billion times greater

But if we halved the radius of the earth we should have one-eighth the gravitation, while we should only reduce the light pressure to one-quarter, or one would be only twenty billion times the other With another halving it would be only ten billion times as great, and so on until, if we made a particle a forty-billionth of the radius of the earth, its gravitation would be balanced by the light pressure if the law held good so far

This effect of diminution of size applies to the radiating body as well If we halved the radius of both earth and sun, the gravitative pull would be one sixty-fourth, while the light pressure would be one-sixteenth, or we should in each halving reduce the ratio of pull to push twice as much, and should much sooner reach the balance between the two, and, of course, the balance would be reached sooner the hotter the bodies. Thus two bodies of the temperature and density of the sun, and about 40 metres in diameter, would neither attract nor repel each other Two bodies of the temperature and density of the earth would neither attract nor repel each other if a little more than 2 cm, or just under an inch, in diameter

Suppose, then, a swarm of scattered meteorites 1 inch in diameter and of the earth's density approaching the sun Out in space their gravitation pull would be greater than their mutual radiation push, and there would be a slight tendency to draw together. When they came within 100 million miles of the sun radiation would about balance gravitation, and they would no longer tend to draw together As they moved still nearer repulsion would exceed gravitation, and there would be a tendency —slight, no doubt—to scatter

It appears possible that this effect should be taken into account in the motion of Saturn's rings if these consist of small particles Let us suppose that Saturn is still giving off heat of his own in sensible quantity, and, merely for illustration let us say that his temperature is about that of boiling mercury, 600° absolute Imagine one of a thinly scattered cloud of particles near the division of the rings At such a distance from the sun the particle will be receiving nearly all its heat from the planet, which will occupy about one-sixteenth of its sky If the planet filled the whole sky the particle would be at 600°, and give out corresponding radiation But filling only one-sixteenth of the sky it gives to the particle and the particle gives out again, only one-sixteenth of the 600° radiation It is therefore it $\sqrt[4]{1/16}$, or half the temperature, 300° absolute, the temperature of the earth Particles in the ring then about 1 inch in diameter would neither attract nor repel each other, and each would circle round the planet as if the rest were absent

Passing on from these mutual actions let us see how radiation pressure will affect a spherical absorbing particle moving round the sun We have already seen that the direct pressure of sunlight acts as a virtual reduction of the sun's pull and a small particle will not require so great a velocity to keep it in a given orbit as a large body will A particle 1/1000 inch in diameter, at the distance of the earth from the sun, and of the earth's density, will move so much more slowly than the earth that its year will be nearly two days longer than ours

In the second place we have the Doppler emission effect The particle crowds forward on its own waves emitted in the direction of motion, and draws away from those it sends out behind There is an increased pressure in front, a reduced pressure behind, and a net force always opposing the motion This force is a very small fraction of the direct sun push, in fact only $\frac{1}{2} \times \frac{\text{velocity of particle}}{\text{velocity of light}}$ of that push

But, unlike that force, it is always acting against the motion, always dissipating the energy The result is that the particle, losing some of its energy, falls in a little towards the sun, and moves actually faster in a smaller orbit The particle we are considering would fall in about 800 miles from the distance of the earth in the first year Next year it would be hotter, the effect would be greater, and it would move in further I think it would reach the sun in much less than 100,000 years. As the effect works out to be inversely as the radius, a particle an inch in diameter would reach the sun in much less than a hundred million years

There is another Doppler emission effect which must be mentioned If the whole solar system is drifting along

relatively to the ether, there is a Doppler resistance to the drift utterly negligible on the sun and planets, but quite appreciable on meteoric dust I confess that I am utterly unable to tackle the equations of motion when this force is taken into account, but if we make rough approximations it seems possible that it too would lead to a gradual approach to the sun The most obvious method of approximation in dealing with a small disturbing force is to omit it Let us adopt this method here, and turn to another effect which can be tackled—a Doppler reception effect, which only comes into play when a particle is changing its distance from the sun

Imagine a particle moving in an elliptic orbit to be coming towards the sun The sun pressure against it is slightly increased by the motion, or, virtually, gravitation is lessened When the particle has swung round the sun and is retreating, the sun pressure is slightly lessened, or, virtually, gravitation is increased That is, there is always a force tending to resist change of distance from the sun, tending, I take it, to make the orbit less eccentric, more circular

Now let us see how these forces will act on a comet, supposing a comet to consist of a somewhat thinly scattered cloud of particles of various sizes down to, say, a ten-thousandth of an inch in diameter Somewhat below that size the particles would be repelled and never tend to approach the sun at all, and would be weeded out of the comet as it first came into our system Let us suppose that, to begin with, the various sizes are well mixed up Then at once a sorting action will begin The direct sun pressure will lengthen out the year of the finer particles more than that of the coarser, and they will gradually trail behind in the orbit

Then the Doppler emission effect will gradually damp down the motion, again more markedly with the finer particles and they will tend to spiral in towards the sun and shorten the period of revolution Then the Doppler reception effect will tend to make the orbit ever less elliptic and again with the smaller particles the action will be more rapid

In any single revolution the effect will no doubt be small, even on the smaller particles, but after thousands or millions of revolutions the particles of different sizes may move in orbits so different that they may not appear to have any connection with each other In course of ages all the smaller particles, and if we have a sufficient balance in the bank of astronomical time even the larger particles, will end their course in the sun itself

There is one member of our system, Encke's comet, which at first sight looks as if it were manifesting these actions even in the short time, less than a century, that it has been under observation Its motion is commonly interpreted as a shortening of its period by 2½ hours in each revolution of 3⅓ years But Mr H C Plummer has investigated its case, and finds such difficulties, difficulties with which I need not now trouble you, that I fear the obvious explanation that the Doppler resistance is the cause must be abandoned But though we may not notice the effects in any short time, I see no escape from the conclusion that if comets are clouds of small particles brought into, and made members of, our system, they at once begin to undergo a sorting action, the finer particles drawing inwards more rapidly, and ultimately ending their career in the sun Possibly the Zodiacal Light is the dust of long dead comets

Where our ignorance is complete and unbounded hardly any supposition can be ruled out Let me, then, in conclusion, make one wild suggestion Suppose that a larger planet, still so hot as to be a small sun, succeeds in capturing a cloud of cometary dust Just the action I have been describing should go on The cloud would gradually spread into a long trail, the larger particles leading, the smaller dropping behind and moving in, and ultimately we might have a ring round the planet, a ring tending to become more and more circular as time went on, with the larger particles outside and the finer particles forming an inner fringe With different grades of dust we might have different rings Is it possible that Saturn has been wild enough to have adopted this suggestion?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Cambridge —The special board for mathematics is now submitting for the approval of the Senate regulations for part i and part ii of the mathematical tripos embodying the resolutions which were adopted by Senate on October 25 It has been found necessary to make provision for the transition from the present system to the new one, and some temporary provisions are suggested for this purpose In other respects all the regulations now submitted have already been published in the draft regulations appended to the report above referred to It is these detailed regulations that the master of Sidney Sussex College and some other members of the Senate have announced their intention to "non-placet"

The observatory syndicate has been considering the great increase in astrophysical work which has been in the last few years carried on in the University observatory by Mr H F Newall It considers the time has come when an assistant of university standing should be appointed to assist Mr Newall, and announces the generous offer of Mr Newall to find 100*l* a year for five years toward the stipend of such an assistant The syndicate recommends (1) that for a period of five years, from January 1, 1907, there be appointed at the observatory an assistant, to be entitled "the assistant in astrophysics," who shall be under the general direction of the Newall observer, (2) that the assistant in astrophysics be appointed by Mr Newall with the consent of the Vice-Chancellor, and be removable in like manner, (3) that a stipend of 100*l* per annum, payable from the University chest, be assigned to the assistant in astrophysics Mr Newall having undertaken to augment the stipend by an annual sum of 100*l* for a period of five years from January 1, 1907

Two largely signed memorials have been presented to the council of the Senate The first urges (1) that a paper or papers in natural science shall be included amongst the compulsory subjects of any examination which may be substituted for the present previous examination, and (2) that in the classical part of such an examination no separate paper in Greek and Latin grammar shall be set The second requests the council of the Senate to appoint a syndicate to consider the advisability of instituting a diploma in architecture in view of the great importance of architectural studies which has already been felt in other universities, where such studies have been successfully organised

The following have been nominated examiners in the mechanical sciences tripos —Prof Hopkinson, Prof W E Dalby, and Mr C F Ingles, in State medicine Dr Anningson, Prof Nuttall Dr J Lane Notter, Dr R D Sweeting, and Dr A Newsholme in the diploma of tropical medicine and hygiene, Prof Nuttall, Mr C W Daniels and Mr W B Leishman

The board of agricultural studies, in consultation with the president of the Royal Agricultural Society, has appointed Major P G Craigie, C B, to be Gilbey lecturer on the history of the economics of agriculture for three years from January 1

A syndicate has been nominated to obtain plans and estimates for the extension of the Cavendish Laboratory on the site recently assigned it by a Grace of the Senate This extension has been rendered possible by the generosity of Lord Rayleigh, who has presented the Nobel prize to the University

Mr Aubrey Strahan, St John's College, has been approved by the general board of studies for the degree of Doctor in Science

A University lectureship in botany is now vacant by the resignation of Prof Seward The general board of studies will shortly proceed to appoint a lecturer to hold office from Christmas, 1906, until Michaelmas, 1911 The annual stipend is 100*l* Candidates are requested to send their applications, with testimonials if they think fit, to the Vice-Chancellor on or before November 30, 1906

Mr R P Gregory, of St John's College has been appointed senior demonstrator in botany until September 30, 1911

Mr A Hutchinson, of Pembroke College, has been

appointed chairman of the examiners for the natural sciences tripos, 1907

DR H E ANNETT has been elected to the newly-established chair of comparative pathology in the University of Liverpool

THE second award of the Vulcan fellowship in engineering of the Victoria University of Manchester will be made this session Applications should be made to the registrar on or before December 10 The fellowship which is of the annual value of 120*l* offers exceptional opportunities for research in engineering It is tenable for one year but may be renewed for a second, and in special circumstances for a third, year

THE *Times* states that the trustees of the late Mr T Graham Young have presented to the governors of the Glasgow and West of Scotland Technical College a sum of 10 000*l* to assist in making provision for the teaching of dyeing and bleaching in connection with the chair of technical chemistry in the college Mr Young's trustees have also voted a sum of 850*l* for the equipment of the laboratory for the chair

THE regulations for admission to the schools of mines at Clausthal and Berlin and to the mining and metallurgical department of the Aachen Technical School have been brought into unison Hitherto, at Clausthal and Berlin on matriculation twelve months' practical experience was demanded, whilst at Aachen no previous practical training was required Moreover, at Aachen the length of the course was three years, whilst at Clausthal and Berlin it was four years Henceforth no practical experience will be demanded for entry at Clausthal and Berlin, but on entering for the first examination students will be required to furnish evidence of six months practical work At Aachen the course will in future cover four years

THE London County Council has decided to expend 37,500*l* in acquiring sites for secondary school and training college purposes in the districts of Clapham Wandsworth North London and Tooting The schools are needed for the scholars elected under the council's new scholarship scheme It is proposed to erect six schools on the sites three for boys and three for girls and to adapt as a training college a mansion at present standing on one of the sites The cost of erecting the six schools will be about 160,000*l* and that of adapting the mansion 8000*l* It is anticipated that four more schools will be needed to provide for the full number contemplated by the scholarship scheme The total expenditure upon the council's proposals with regard to secondary schools is estimated at 575,000*l*

A MOVEMENT has been started for the reconstitution of Queen's College Cork and its conversion into a university centre for Munster Speaking at a meeting convened on Saturday last by the Lord Mayor of Cork and Mr McDonald chairman of the County Council Mr William O'Brien M P, said it is proposed to do in Cork what has been done in Birmingham The institution to be set up will be purely democratic It will belong to the people, and will be governed by the people's representatives The governing purpose of the university will be to open up a career in life to every gifted child in the province Mr O'Brien and his wife have decided to bequeath on their demise practically all their property as a contribution towards the endowment of a Cork University Mr O'Brien said it should be possible to arrange, if the borough and county councils of the province are willing to assume a temporary burden which will be an exceedingly slight one, and every shilling of which will be repaid at his and his wife's death, that a sum of 50 000*l* can be at once made available

THE recently published annual report on the work of the Glasgow and West of Scotland Technical College supplies as an appendix a report on a visit to American educational institutions, presented to the governors by Mr H F Stockdale the secretary and director of the college The subject of the director's inquiry was especially the equipment of the engineering schools visited, with a view to the economical and judicious expenditure of the grants made to the engineering departments of the Glasgow college Mr Stockdale insists that the only points where the superiority of American schools must be admitted are those in which the weight of money turns the scale The laboratory equipments are generally far more extensive and include more costly apparatus than is within the means of most British colleges The environment of certain American institutions, such as that of the University of Wisconsin and of Cornell University, is, too, a great advantage The director was much impressed by the facilities in the States for the study of railway mechanical engineering, and he points out that this seems to be a field in which the Glasgow college might do good work An Englishman in charge of a section of the metallurgical department of Columbia University alleged that many British students proceed to the States to study metallurgy Like other British visitors to America, the Scottish director saw and heard with envy the large number of able men on the staff in nearly all the best colleges in the States, and noted that the heads of departments are allowed plenty of time for research The circumstance that the large staffs make it possible for professors to engage in outside professional practice, to the advantage of the work of their colleges, is also commented upon Mr Stockdale has written a very useful report, which will repay attention from educational authorities

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 1 —Prof R **Meldola**, F R S, president, in the chair —A development of the atomic theory which correlates chemical and crystalline structure and leads to a demonstration of the nature of valency W **Barlow** and W J **Pope** The authors represent atoms in the combined state by "spheres of influence" An examination of the geometrical properties of closely-packed assemblages of spheres shows that the atoms of the elements must be represented by spheres of influence directly proportional in volume to their fundamental valencies, and that a closely packed assemblage built up of spheres of the appropriate sizes, so as to represent some particular compound, can be partitioned into units identical with the chemical molecule, and possesses symmetry and dimensions compatible with those of the crystalline substance In addition, it is shown that close-packed homogeneous assemblages of spheres possess other properties which lead to simple interpretations of multivalency and tautomerism and that ethylenic and acetylenic bonds and isomerism have complete analogues in peculiarities of homogeneous assemblages of spheres —Synthesis of carvestrene Preliminary notice W H **Perkin**, jun, and G **Tattersall** —Some derivatives of catechol, pyrogallol, benzophenone, and of some substances allied to the natural colouring matters W H **Perkin**, jun, and C **Weizmann** This communication contains descriptions of the preparation and properties of a number of new substances obtained at different times in connection with researches on the constitution of brazilin hæmatoxylin and other natural colouring matters —Experiments on the synthesis of the terpenes part ix the preparation of *cyclo*pentanone 4-carboxylic acid and of *cyclo*hexanone-4 carboxylic acid (δ ketohexahydrobenzoic acid) I W **Kay** and W H **Perkin**, jun —The hydrolysis of "nitrocellulose" and "nitroglycerine" O **Silberrad** and R C **Farmer** The hydrolysis is complicated by the simultaneous reduction of the nitric acid, and intermediate products are formed, which are gradually acted upon by the alkali these are practically insoluble in water and do not give rise to free acid when left in contact with water for several days —The acidic constants of some ureides and uric acid derivatives J K **Wood** In compounds which contain the grouping CO NH CO NH CO, there appears to be a mutual reinforcement of the imino-groups by the carbonyl groups present analogous to that exhibited by the carboxyl groups in succinic acid —The affinity constants of xanthine and its methyl derivatives J K **Wood** The results of determinations of the basic and acidic constants of xanthine, 7-methylxanthine, the three isomeric dimethylxanthines, and caffeine are described —The explosive com-

bustion of hydrocarbons, ii W A **Bone**, J **Drugman**, and G W **Andrew** The "inflammation" of mixtures of ethane or ethylene and oxygen has been studied In each case, steam, aldehydes, ethylene, and acetylene are prominent during the initial stages of combustion, whilst carbon is a later product —Contributions to the theory of solutions, i, the nature of the molecular arrangement in aqueous mixtures of the lower alcohols and acids of the paraffin series, ii, molecular complexity in the liquid state, iii, theory of the intermiscibility of liquids J **Holmes** —The relation between natural and synthetical glyceryl-phosphoric acids, part ii F **Tutin** and A C O **Hann** It is concluded from the results obtained that the natural and synthetical glyceryl-phosphoric acids are differently constituted mixtures of the α and β acids —Thiocarbonic acid and some of its salts Miss I G **O'Donoghue** and Miss Z **Kahan** The acid has the formula H_2CS_3 The salts are very unstable even in a vacuum —Studies in optical superposition, part ii T S **Patterson** and J **Kaye** The optical properties of di-*l*-menthyl-*l*-tartrate, di-*l*-menthyl diacetyl-*l*-tartrate and sodium *l*-menthyl *l*-tartrate have been examined —Optically active dihydrophthalic acid A **Neville** When the hydrogen strychnine salt of *trans* $\Delta^{2\cdot 5}$-dihydrophthalic acid is fractionally crystallised from alcohol, the acid is resolved into its *laevo-* and *dextro-*isomerides which are described

Entomological Society, November 7 —Mr F Merrifield, president, in the chair —*Exhibitions* —H J **Lucas** Photograph of *Panorpa germanica*, practically immaculate from Sutherlandshire, and a typical form for comparison, corresponding apparently to the *borealis* of Stephens Also a series of the genus to illustrate the range of spotting on the wings of both sexes —G C **Champion** A long series of a Henicopus (probably *H spiniger*, Duval), from El Barco, Galicia Spain to demonstrate the dimorphism of the females —H St J **Donisthorpe** Seven specimens of *Prionocyphon serricornis*, Mull bred from larvæ taken in the New Forest in July, live larvæ, and a larva and pupa figured, of the same, with a note on the species —Dr T A **Chapman** (1) A collection of butterflies, made in Galicia (lat 42° 16′ N, long 6° 44′ W) last July, including *Lycæna idas*, hitherto reported only from the Sierra Nevada, in the south-east of Spain (2) *L argus* (*aegon*) from the same district which though very close to the vars *hypochiona* and *bejarensis*, differed in a certain proportion of the specimens presenting the red of the marginal "peacock eyes" on the upper surface of the hind wings of the males —Hon N C **Rothschild** Branches of *Viburnum lantana* showing the mines of *Sesia andreniformis*, now discovered as the food plant of the species in Britain for the first time —F D **Jones** Two species of the genus Mollipa bred from Brazilian larvæ which were identical in form also photographs of the larvæ *in situ* —Dr F A **Dixey** A case of female Pierine butterflies to illustrate various conditions under which white pigment might be replaced by black He said that though melanism may occur as a sport it owed its establishment to the principle of selective adaptation —The **President,** mentioning a bug which Mr Cecil Floersheim had found very destructive to the eggs of *Papilio machaon* and *P asterias* said that it was remarkable to find one of the Heterotoma as a carnivorous species

Faraday Society November 13 —Dr F Mollwo Perkin, treasurer, in the chair —Some investigations relative to the depreciation of electrolytically produced solutions of sodium hypochlorite W P **Digby** This deals in the first place, with depreciation taking place in bottles of various colours in which dark amber bottles gave the best results the loss in 1817 days being about 40 per cent for a solution containing 4 216 grms of available chlorine per litre The corrosive action of hypochlorite solutions upon various metals is then discussed and the depreciations due to graphite, copper, zinc, lead and iron plates immersed in such solutions are set forth for a period of 480 hours A much greater depreciation takes place, due to galvanic action, when two dissimilar metals immersed in the liquid are connected by an insulated wire the paper gives records in the case of twenty-one different couples When iron is present as one metal in such a couple the depreciations are generally greater than for any two other metals —The Hermite electrolytic process at Poplar, C V **Biggs** This paper is a contribution to the data at present available on the subject of the electrolytic productions of hypochlorites It consists of a description of the plant in use at Poplar for the preparation of a solution containing about 4 5 grms of available chlorine per litre, for use as a disinfectant in the borough The author concludes that the magnesium hypochlorite, as made at Poplar, is sufficiently stable for practical purposes, and that it could be made in a warm climate without necessarily rapid deterioration —The electrochemistry of lead Dr A C C **Cumming**

CAMBRIDGE

Philosophical Society, October 29 —Dr Fenton vice president in the chair —The procession of *Cnethocampa pinivora* H H **Brindley** The processionary larva of this moth, one of the Eupterotidæ, which is common in the *Pinus maritima* districts of the Landes, marches in single file both in its nocturnal excursions from its nest in the pine to feed on the young leaves and also in the journey from the nest tree to pupate in the sand The primate spins a thread which is added to by the satellites in succession Fabre ("Souvenirs entomologiques," ser vi) describes many observations made in his laboratory near Avignon with imported families The author found a procession of 114 larvæ in the Cap Ferret Woods, Arcachon, on April 2, in the final procession for pupation Interruptions and rearrangements of the procession were made with results in the main in accord with Fabre's account, but in spite of much contact with bare hands the irritation from the poison hairs found by Fabre to be at a maximum in this stage, was not noticed Also the number of contiguous individuals removed was found to affect the mode of re forming the procession The procession was being attacked by a Tachinid fly, probably *Dexodes machairopsis* endeavouring to lay eggs in the larvæ and these seemed afraid of the hairs though one fly ran over the back of a larva and lanced it near the hind end As a rule a fly propped itself on the edges of its wings and faced the larva, pushing it with its legs as it passed, and apparently trying to insert its ovipositor ventrally between the pro podia Failures to insert the eggs seemed very numerous The larvæ evidently felt the lancing acutely always starting violently when it succeeded The intention to burrow seemed very little interfered with by interrupting the chain daughter chains started in different directions the primate soon burrowing in the nearest depression and disappearing in ten to fifteen minutes, while the satellites quickly followed his example The complete procession and the daughter ones made by interference, seemed to march towards the greatest sunlight —A note on a collection of Oribatidæ from British Guiana C **Warburton** and N D F **Pearce** Our knowledge of such microscopic land animals as the Oribatidæ rests almost entirely on European and North American forms because it is impracticable on scientific expeditions to collect individually creatures so minute It has been found however that moss or other material in which the mites live if packed in air-tight (preferably soldered) tins reach England from the most distant countries in such a satisfactory condition that the animals in it may be examined alive Some moss received in this way from British Guiana last June yielded a result which strikingly illustrates the importance of this method of collection About forty species new to science were found in it a fact the more remarkable in that the total number of satisfactorily established species of Oribatidæ previously known did not exceed 250 Some of the new forms are extremely interesting and will certainly necessitate a revision of the existing genera —The influence of spectral colours on the sporulation of various species of Saccharomyces J F **Purvis** and G R **Warwick** The light of a strong lamp was filtered through various coloured screens and played upon the surfaces of several species of pure cultures of Saccharomyces in an incubator at a definite temperature of 24° C to 25° C The results were compared with the effect of ordinary white light from the same lamp and also when the yeasts were allowed to sporulate in the dark but at the same temperature as the yeasts sporulating under the influence of the spectral colours of red green blue, and violet The conclusions were (1) red rays appeared to accelerate the formation of spores more quickly than white light (2) the green rays retarded the development of the spores (3) the blue and violet rays retarded

the development more than the green rays, (4) the violet and ultra-violet rays were still more effective, and they appeared to break down and disintegrate the vitality of the cells when the latter were kept for some time under their influence

PARIS

Academy of Sciences, November 12.—M. H. Poincaré in the chair.—Observations relating to equilibrium and reciprocal displacements between glycerol and other alcohols: M. **Berthelot**. The author refers to his experiments made between 1853 and 1862, and doubts the utility of the introduction of the words hydrolysis and alcoholysis.—A new and rapid method for the determination of the errors of division of a meridian circle: M. **Loewy**. A mathematical development of the method described in previous papers.—Some products of the fumerolles of the recent eruption of Vesuvius, with particular reference to the minerals containing arsenic and lead: A. **Lacroix**. The most abundant solid products of the fumerolles are those commonly found in all eruptions of Vesuvius, chlorides of iron, sodium, potassium, magnesium, and calcium, none of them well characterised from a mineralogical point of view with the exception of erythrosiderite. These chlorides are covered locally with realgar. The presence of galena has also been noted, the first time this mineral has been associated with the products of eruption of Vesuvius. Accompanying the galena were found magnetite, magnesioferrite, hæmatite, pyrrhotite, and pyrites.—Contribution to the study of the calorific emission of the sun: C. **Féry** and G. **Millochau**. A discussion of the results obtained by methods described in earlier papers. The measurements showed that there exists a distinct radiation outside the sun's disc, partly due to the dimensions of the thermocouple, but partly also to a calorific emission external to the solar image. On the assumption that the sun's nucleus acts as a black body, an attempt is made to correct the observed values for the absorption due to the solar atmosphere: the temperature obtained in this way lies between 5963° and 5888° absolute. The absolute error in the determination of a temperature in the neighbourhood of 6000° abs. is estimated to be of the order of 15°.—The photographic study of the telluric lines in the infra-red spectrum: Milan **Štefánik**. A description of observations carried out at the summit of Mt. Blanc. A comparison of two spectra obtained with a grating, one about noon and the other at 6 p.m.—Observations of the sun made at the Observatory of Lyons during the third quarter of 1906: J. **Guillaume**. The results are exhibited in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Groups of functions: Frédéric **Riesz**.—Differential equations of the second order and of the first degree the general integral of which is at fixed critical points: M. **Gambier**.—The relative value of standards of light, Carcel, Hefner, and Vernon Harcourt: A. **Perot** and M. **Laporte**. Taking the Harcourt lamp as unity, the Carcel is 0.996 and the Hefner 0.0931. The experiments brought out the difficulties inherent to the use of flame standards, and show the necessity of having an absolute standard as independent as possible of external conditions, such as the Violle standard.—The reduction of molybdic acid in solution by molybdenum, and the titration of reducing solutions by permanganate: M. **Guichard**. The brown solution obtained by the reduction of an acid solution of molybdic acid by molybdenum contains not a salt of the dioxide but a salt of the oxide Mo_2O_5. The conclusion is drawn that the dioxide of molybdenum does not form salts. The use of iron reduced from the pure oxide is recommended for standardising permanganate solutions.—The heat of combustion and of formation of some amines: P. **Lemoult**.—Xanthone and xanthydrol: R. **Fosse**. It is known that xanthone, although containing a ketonic oxygen, does not form directly a phenylhydrazone or an oxime. The reduction product of xanthone, xanthydrol, on the other hand, reacts directly with hydroxylamine and with semicarbazide.—The condensation of *o*- and *p*-nitro-benzyl chloride with acetylacetone: H. **Mech**.—The existence in Corsica of alkaline quartz porphyry, and a remarkable layer of orthose: M. **Deprat**.—The reproduction of the fig: Leclerc **du Sablon**.—The motor equivalent of resistant work in animal energetics: Jules **Lefèvre**.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 22.

ROYAL SOCIETY, at 4.30.—Studies on the Development of Larval Nephridia, Part ii. Polygordius: Dr. Cresswell Shearer.—The Structure of Nerve Fibres: Prof. J. S. Macdonald.—On Opsonins in Relation to Red Blood Cells: Dr. J. O. Wakelin Barratt.—On the Inheritance of Certain Invisible Characters in Peas: R. H. Lock.—The Influence of Increased Barometric Pressure on Man, No. 2: Leonard Hill, F.R.S., and M. G. Greenwood.—The Influence of the Kidneys on Metabolism: Dr. F. A. Bainbridge and Dr. A. P. Beddard.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Selection and Testing of Materials for Construction of Electric Machinery: Prof. J. Epstein.

FRIDAY, NOVEMBER 23.

PHYSICAL SOCIETY, at 5.—On the Electrical Radiation from Bent Antennæ: Prof. J. A. Fleming.—Auroral and Sun-spot Frequencies contrasted: Dr. C. Chree.—The Electrical Resistance of Alloys: Dr. R. S. Willows.

SATURDAY, NOVEMBER 24.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Report of Club's Delegate at York Meeting of British Association: F. W. Rudler.—Various Exhibits from Essex.

MONDAY, NOVEMBER 26.

SOCIETY OF ARTS, at 8.—Artificial Fertilisers, the Fixation of Nitrogen: A. D. Hall.

LONDON INSTITUTION, at 5.—Egypt, Past and Present: Raymond Blathwayt.

INSTITUTE OF ACTUARIES, at 5.—Inaugural Address by the President, F. B. Wyatt.

TUESDAY, NOVEMBER 27.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Talla Water-supply of the Edinburgh and District Waterworks: W. A. P. Tait.—Repairing a Limestone concrete Aqueduct: M. Ratcliffe Barnett.—The Yield of Catchment areas: E. P. Hill.

ZOOLOGICAL SOCIETY, at 8.30.

WEDNESDAY, NOVEMBER 28.

SOCIETY OF ARTS, at 8.—Patent Law Reform: J. W. Gordon.

FRIDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Applications of Electricity in Printing works: P. A. Spalding.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Steam as a Motive Power for Public Service Vehicles (Discussion): T. Clarkson.

CONTENTS.

THURSDAY, NOVEMBER 29, 1906

ALTERNATING CURRENTS

***Alternating Currents** a Text-book for Students of Engineering* By C G Lamb Pp vi+325 (London Edward Arnold, n d) Price 10s 6d net

THIS book is designed to be a text-book for students of engineering, more particularly for those who are going through a course at the engineering laboratory at Cambridge In any attempt to write an account of alternating currents for such a purpose, the question arises at once, Out of all the materials at the disposal of the author, what should be selected as being most suitable, or on what principle should such a selection be made? The answer to this question may perhaps be best given by considering the requirements of engineering students Chiefly, perhaps, the mind must be trained to accurate thought, but, apart from this, which is common to all scientific education, a student should acquire a thorough knowledge of fundamental principles in such a way that he may have confidence in himself when he is faced with the various problems that constantly arise in the course of his professional career Beyond this, he should be taught sufficient of the methods of procedure in common use, so that when he takes up his first appointment in a subordinate position he will be able to follow with intelligence the methods of practice used by his superiors As Mr Lamb remarks in his preface, details of actual practice are unsuitable in such a book, and are best learned by actual contact with drawing-office work

If the book in question be examined in the light of these principles, it will be seen that the statements of the fundamental ideas are very clear, and are logically followed up It might, perhaps, be suggested that there is a tendency to explain various actions by means of equations rather than by physical conceptions One is somewhat reminded of the mathematical coach lecturing on optics, who introduced the subject of optical instruments with the remark that a telescope is defined by the equation K=0 Many students are naturally inclined to view physical problems in this way, and such a tendency should be checked, especially among intending engineers

With regard to the methods of procedure in common use, it cannot be said that this book is irreproachable In particular, practically no mention is made of the necessity of designing apparatus to meet a given temperature specification This necessity makes itself felt throughout almost the entire range of electrical apparatus, and yet with the exception of one brief paragraph the subject of temperature rise is not mentioned A student reading this book with no other source of information at his disposal might be excused for imagining that apparatus was usually designed without any definite ideas as to its capacity, and was only rated after it had been manufactured and tested to see what it would stand This must be regarded as an unfortunate omission

Turning now to the consideration of the book in detail, it should be remarked that a certain extent of previous acquaintance with elementary theory is assumed, chiefly the theory of magnetism, including hysteresis and eddy currents, and a knowledge of vectors The author has not attempted to introduce any symbolic treatment, no doubt very wisely

The first seven chapters cover the preliminary statements of the usual methods of treating alternate-current problems in general, also of measuring instruments, and discuss the theory of the single-phase transformer This piece of apparatus is regarded first of all in the light of a choking coil, for which the fundamental vector diagrams are obtained Following this the analytical expressions for an actual transformer are worked out, and methods are described whereby the regulation can be calculated The fifth chapter concludes with a paragraph giving a few constants for a modern type, which might have been more valuable if some indication had been given as to how such constants vary over a range of transformers for different outputs and frequencies, and with different load factors Special types of transformer occupy the sixth chapter, in which mention might have been made of sucking—or booster—transformers, to be quite up to date, while the seventh chapter is devoted to efficiencies

Apart from the points mentioned, which are not important, the foregoing chapters may be said to be excellent both in matter and in manner Unfortunately, the same cannot be said of the very brief mention of single-phase commutator motors which occupies the eighth chapter This part gives one the impression of having been put in as an afterthought, neither the repulsion motor nor the compensated repulsion motor is mentioned, and the type of series motor illustrated is already antiquated, moreover, the self-induction of the whole motor cannot be reduced to that of the field coils alone (p 95)

The rest of the book is devoted to the consideration of alternators both as generators and motors, and of induction motors Without following the treatment too closely, it may be remarked that wave forms are considered with reference to the presence of harmonics, the properties of concentrated and distributed windings are set out, and towards the end of the book armature reaction is considered in detail

The treatment of the latter subject is based chiefly on the method of synchronous reactance, in which the whole reaction is considered simply as due to a single internal self-induction This method has several drawbacks, and for practical work it is better to look upon the action of the armature as partly a demagnetising effect and partly a self-induction This treatment is very simple, and sufficiently accurate if proper constants are taken In chapter xxi of Mr Lamb's work the armature reaction is dealt with in greater detail, and is split up into three components, viz stray field reactance, cross and back reactances, each of which has its own magnitude and its own phase It is stated that this method leads to very good results, but it is more cumbersome, and seems to contain as much liability to error as the method above alluded to

Space will not permit of more than a brief reference to many of the subjects dealt with Induction motors are discussed with reference to the well known Hey-

land circle diagram, and emphasis is laid on the necessity for proper phase relations being maintained between the applied voltages A short chapter is devoted to induction meters, the principles of which are explained analytically and graphically

Compound alternators are referred to somewhat scantily, only two types being described both of which are manufactured by the Westinghouse Company The parallel running of alternators is examined by the aid of synchronous reactance and various methods of synchronising such machines are described

The operation of synchronous motors is treated in the same way at considerable length and an interesting graphical method is given for finding the value of the motor E M F for any given load, due, we understand to Mr G T Bennett of Emmanuel College, Cambridge There is a short reference to the hunting of such motors and to the action of the amortisseur The book concludes with a chapter on the rotary converter with special paragraphs on the E M F relations, current relations and ohmic loss, starting, pressure regulation efficiency and hunting

It may be remarked that no mention whatever is made of transmission lines a subject which would naturally be included in a book such as this, but possibly the author may have adequate reasons for the omission

Apart from criticism of the contents of the book, it is necessary to direct attention to one point referred to in the preface, viz the question of references to previous writers whose works have been requisitioned It is quite true that such references are not of great value to the student, and would be unnecessary for others if no original matter were introduced This however, is not the case, and it is unreasonable to assume that the learned persons, mentioned by Mr Lamb, who read the book will be acquainted with the authorship of this original matter The number of engineers who are practically familiar with all branches of alternating-current science must be very small, and anyone wishing to study a particular branch from Mr Lamb's book would naturally ascribe to him the credit for some of the original matter contained therein In a few places, contributions have been abstracted from the proceedings of learned societies without a word of acknowledgment Rather than adopt such a course it would be better to adhere to the system in vogue in Germany, where a man who writes a book on any subject without supplying with it a complete bibliography is considered a hopeless amateur

THE CELL AND HEREDITY

Die stofflichen Grundlagen der Vererbung im organischen Reich Versuch einer gemeinverständlichen Darstellung von Eduard Strasburger Pp viii+68 (Jena Gustav Fischer, 1905) Price 2 marks

THIS little sketch of the cell as the bearer of the hereditary qualities of the organism is full of interest, like everything that springs from Prof Strasburger's pen It is written in somewhat popular style, but is nevertheless a thoughtful and real contribution to the literature of the subject

The book opens with a brief but sufficient account of the processes associated with the formation of the sexual elements, and with the outlines of nuclear division in so far as they are necessary for the understanding of the main problem

The author follows current opinion in laying great stress on the qualitatively equal division of the chromosome secured by the mode of longitudinal fission of the chromatic thread and he regards the chromosomes themselves as permanent elements of the cell nucleus He explains in detail what is meant by "reduction-divisions," whereby the number of chromosomes in the sexual cells becomes reduced to one-half that characteristic of the nuclei of the body cells of the animal or plant This reduction is dependent on the circumstance that the paternal and maternal chromosomes, which at sexual fusion are contributed to the fertilised ovum, remain distinct in the nucleus of that and the succeeding cells which originate from it But at some period in the life-cycle certain cells all or some of the descendants of which are destined to give rise again to sexual elements exhibit two well-marked nuclear divisions that follow rapidly upon each other In this way a definite phase (termed by some writers the maiotic phase) is intercalated in the cellular life-cycle of the organism and it marks the transition from the cells with "unreduced" to those in which the nuclei possess the "reduced" number of chromosomes

The essential feature connected with the maiotic phase lies in the manner in which the reduction in the number of the chromosomes is effected Instead of a distribution to each nucleus of respective moieties of every chromosome taking place, as in the ordinary nuclear divisions, *entire* chromosomes first become temporarily united in pairs, and then the two members of each pair diverge from each other and, aggregating into two groups give rise to two nuclei each of which thus respectively contains half the whole complement of chromosomes present in the original nucleus

There is some divergence of opinion as to the exact method by which the association and subsequent distribution of the chromosomes is effected during the maiotic phase, and perhaps it may vary somewhat in different organisms, but there is a general agreement as to the final result

There exists a considerable weight of evidence tending to prove that the different chromosomes are responsible for different characters or groups of characters in the organism as a whole, and this circumstance is to be correlated with the fact that an equal number of these bodies is normally furnished to the fertilised ovum by each parent Each chromosome, therefore, which is derived from the one parent will have its homologue or duplicate originating from the other The importance of this becomes manifest when the facts of reduction are considered in relation to the behaviour of hybrids or crosses, in which a given character or group of characters (allelomorphs of Bateson) differs in the two parents When such

varieties are crossed, the character of one of the parents is commonly alone visible, but the (different) character of the other is really present, though latent, in the offspring. On again crossing the latter these latent characters reappear, and often in a very definite proportion, in this second generation.

This fact was discovered many years ago by Mendel, and has formed the basis of most of the recent experimental work that has thrown so much light on the problems of heredity. But although it harmonises, in a large number of cases, with the expectation based on a study of nuclear division, there are many things which still require explanation. Prof. Strasburger has touched on some of these, thus, for instance, the proportion of the sexes in many unisexual plants and animals is an almost invariable one, and appears to be inexplicable on the view of the chromosomes above indicated. On the other hand, we know, especially amongst animals, of cases in which the sex of the offspring can be definitely affected by conditions that are under control, although further study is necessary for their thorough elucidation. The assumption of entirely new characters again provides a field of research that is yet can hardly be said to have been explored at all except statistically, and it is at the same time one that is certain to yield most profitable fruit.

These and many other points are raised in the pages of a booklet which, while of small dimensions, is replete with material for thought. Prof. Strasburger has shown that a popular exposition does not necessarily connote a superficial treatment of a difficult subject.

J. B. F.

DISEASE AND ITS PREVENTION.

(1) *Immunity in Infective Diseases.* By Prof. Elie Metchnikoff. Translated from the French by Francis G. Binnie. Pp. xvi+591. (Cambridge University Press, 1905.) Price 18s. net.

(2) *The Inflammation Idea in General Pathology.* By Dr. W. H. Ransom, F.R.S. Pp. vi+354. (London: Williams and Norgate, 1905.) Price 7s. 6d.

(3) *The Milroy Lectures on Epidemic Disease in England. The Evidence of Variability and of Persistency of Type.* By Dr. W. H. Hamer. Pp. 72. (London: Printed at the Bedford Press, 20 and 21 Bedfordbury, W.C., 1906.)

(4) *Microbiologie Agricole.* By Dr. Edmond Kayser. Pp. xii+439. (Paris: Librairie J. B. Baillière et Fils.) Price 5 francs.

(1) PATHOLOGISTS will welcome this translation of Prof. Metchnikoff's great work on immunity, containing as it does the results of twenty years' work devoted to the subject. Commencing with some introductory remarks on the importance of immunity, the author passes on to review the phenomena of immunity in unicellular animals and in multicellular plants, the resorption of formed elements and of albumenoid fluids in animals, instances and mechanism of natural immunity against micro-organisms, the problems of acquired immunity against micro-organisms and of natural and artificial immunity against toxins, and the comparative immunity of the skin and mucous membranes to microbial attacks. A chapter on protective vaccinations, and another giving a useful summary of the whole subject and an historical sketch of our knowledge of immunity conclude the volume.

The dominant idea running through the whole book and supported with the greatest ability and ingenuity, is that the means of defence of the organism against the invasion of micro-organisms lie principally, if not entirely, with certain of the wandering cells of the body, "phagocytes," which comprise some of the leucocytes, and probably also certain endothelial and fixed connective tissue cells. These phagocytes either directly attack the invaders, enveloping and digesting them (phagocytosis), or in the case of toxins unite with these and prevent their toxic action, or secrete or produce as a result of their disintegration substances which are bacteriolytic and bactericidal for micro-organisms and occasionally antitoxic for toxins. Under natural conditions it is chiefly against the microbes and not against their toxins, that the organism has to defend itself, and hence phagocytosis normally is all important. It used to be supposed that the body fluids were bactericidal, and the blood serum *in vitro* frequently possesses marked bactericidal properties, but Metchnikoff and his co-workers, particularly Gengou, have shown that the blood *plasma* in such cases before coagulation has occurred is almost devoid of bactericidal power, but after coagulation the breaking down of leucocytes which accompanies this phenomenon apparently gives rise to the bactericidal substances in the *serum*.

There is little to criticise in the book. It is somewhat difficult to grasp exactly what cells Prof. Metchnikoff regards as phagocytic, as his nomenclature of the leucocytes differs essentially from that used by most pathologists. In the chapter on preventive inoculation Haffkine's anti-choleraic inoculation is criticised in a manner hardly justified in view of the excellent results shown by the statistics of Simpson and others. In certain places the statements are not quite up to date, since the book in the original was published in 1901.

The volume is fascinating reading, and anyone who first dips into it will in all probability do more and study it deeply. It forms a complete statement of the phagocytic hypothesis, and a masterly summary of the whole subject of immunity up to 1902.

(2) It is somewhat difficult to grasp exactly what the author of this book wishes to impart to his reader. Apparently it is his desire to formulate a conception of inflammation which shall be applicable to all organisms, animal and vegetable. The author believes that pathologists have always considered that inflammation is the first stage towards repair after an injury. But this is hardly so, it would be more correct to say that pathologists hold that the phenomena of inflammation *generally tend towards repair*, which is a conception distinctly different from that assumed by Dr. Ransom. According to him, an

injury in any organism is followed by responses misdirected and always damaging, "these misdirected perturbed responses are inflammation" . "It is distinguished from repair, for it is a perturbation thereof" This theme is supported by a number of examples, principally derived from injuries, &c, in vegetable organisms

(3) In these Milroy lectures Dr Hamer gives a brief but fascinating account of some of the plagues and pestilences that ravaged England and Europe during the early and Middle Ages, and attempts to unravel the nature of some of these That principally dealt with is the "sweating sickness," a mysterious disease which appeared in England in 1485, and recurred again and again By careful analysis this disease is proved to be epidemic influenza A consideration of the records of measles and of small-pox leads to the conclusion that these two diseases have maintained a wonderful fixity of character

(4) This book should usefully serve the purpose for which it is intended, viz to give an account of microbial activity in relation to agriculture The introduction on the morphology and classification of the bacteria is perhaps not altogether satisfactory, but the succeeding portions of the book successfully epitomise the subjects of nitrification and denitrification, the fixation of atmospheric nitrogen by the agency of various micro-organisms, and the various industries dependent on microbial activity Under the last heading the alcoholic, acetic, and lactic fermentations are dealt with at length, also bread and sugar making, ensilage, flax and tobacco manufacture, and tanning The book thus gives a very complete account of fermentation processes, is illustrated with a number of figures, and can be cordially recommended

R T HEWLETT

CAPTAINS OF CHEMICAL INDUSTRY

Some Founders of the Chemical Industry Men to be remembered By T Fenwick Allen Pp xxiii + 289 (Manchester and London Sherratt and Hughes, 1906) Price 5s net

THIS book consists of a series of biographical sketches of men whose claim to remembrance is mainly based on their connection with the development of the great chemical industry of Lancashire and the North, viz, the manufacture of alkali and of the other chemical products which are directly associated with that industry These sketches originally appeared in the *Chemical Trade Journal*, and Mr Allen has done wisely in putting them together and republishing them in book-form, and thereby rendering them more readily accessible to all who are interested in the personal history of technology

The book deserves to be in the library of every polytechnic and technical school in the country Although it deals with only a special branch of chemical industry, that branch, in point of magnitude and commercial value, is by far the most important of our chemical manufactures The story of its rise and progress, as illustrated by the biographies of its founders, is one of the most interesting and fascinating chapters in the history of industry in this country. Dr. Smiles has done much by biographical narrative to popularise what may be called the romance of industry, and it cannot be doubted that his works have served to fire the ambitions and to stimulate the endeavours of hundreds of earnest, thoughtful, young men. But the life-history of his heroes, and the story of their struggles, their disappointments and successes, is not a whit more marvellous or more enthralling than the stories of such men as Gossage, Gamble, Muspratt, Andreas Kurtz, or Henry Deacon No chemical technologist—be he young or old—can rise from the perusal of even the most meagre account of their life-work without realising that genius in chemistry is to be found as much in its applications to the material benefit of mankind as in the elucidation of its scientific truths

The men who collectively founded and developed in this country the several manufactures which are comprehended under what is known as the alkali trade sprang, for the most part, from the lower middle class They were persons of very small means, imperfectly educated, and with very little knowledge, to begin with, of chemistry It is difficult, indeed, in some cases to discover why they should have turned their attention to chemical pursuits Gossage was born in a small Lincolnshire town, Gamble was an ordained minister of the Presbyterian kirk in Enniskillen, Muspratt was also an Irishman—a rolling stone, who tried the army and then the navy, before he settled down to chemical manufacture, Deacon was a Londoner, and apprenticed to an engineering firm, Allhusen started life in the grain trade, and Peter Spence's father was a hand-loom weaver in Brechin, who apprenticed him to a grocer Not one of them was predisposed by the circumstances of his origin or home-life to take up chemistry, of which science, indeed, he could have no knowledge until long after the age at which most young men nowadays begin their life-work Deacon's bent may possibly have been determined by his association, as a boy, with Faraday, but it is more than likely that it was the failure of the engineering firm to which he was apprenticed that changed the current of his life and made him a glass-maker at St. Helens

However different they might be in temperament, in habits of mind, and in intellectual tendencies—it is impossible to conceive, for example, two more sharply contrasted characters than James Muspratt and Peter Spence—all the men had certain gifts in common, chief among which were imagination and invention, pertinacity and resource, courage and self-reliance Some of them, and not always the most talented, became wealthy; others, greatly daring, brought themselves to the verge of ruin in what seemed at the time heroic but hopeless struggles with the vagaries of a chemical process These men pursued chemical manufacturing with all the keenness of scientific investigation, and wrestled with difficulties for the pure love of conquest

Mr Allen tells the story of their hopes and disappointments, their failures and triumphs, and tells it very well We heartily commend his book to all who are interested in industrial progress, and in particular to chemical students who desire to know some-

thing of the personal history of those pioneers in technology who have been so largely instrumental in bringing one of our staple industries to its present pitch of development T E. THORPE

AIDS TO PHOTOGRAPHY

(1) *The Year-book of Photography for* 1906–7 Edited by F J Mortimer Pp 618 (London The *Photographic News*, 1906) Price 1s paper, 1s 6d cloth

(2) *The Photographic Picture Post-card* By E J Wall and H Snowden Ward Pp 104 (London Dawbarn and Ward, Ltd, 1906) Price 1s net

(3) *Magnesium Light Photography* By E J Mortimer Pp 88 (London Dawbarn and Ward, Ltd., 1906) Price 1s net

(1) THE present number is the forty-seventh issue of this hardy annual, and the amateur or professional photographer will not have much to complain about when he has entirely digested its contents In its present form it is a mine of photographic information, and contains data which are indispensable to every worker Thus there are useful hints for negative making and finishing, complete and up-to-date directories of the photographic societies of the United Kingdom, a collection of useful recipes, formulæ, and reference tables of general use for every kind of work

In addition to these and many other data which are valuable to the working photographer, there is a series of very interesting and helpful articles These have been written by such well-known men as Robert Demachy, Walter Benington, George E Brown, E J Wall, and others, and are on those particular subjects which have brought their names in the front rank Two full and very practical articles on bromide and gas-light printing are contributed by the editor, and these contain much that is new and useful to the practical worker

In fact, the volume should naturally find itself in the hands of every photographer, and is an indispensable book of reference Sixteen full-page illustrations on art paper accompany the text, and an excellent index completes the volume

(2) In this book the authors describe the making of picture post-cards from the initial sizing of the card down to the finished article The beginner should find no trouble in following the instructions laid out, for the authors have described the various manipulations in clear and concise language

Chapters are devoted also to photomechanical processes of producing a number of cards of one subject and to colouring post-cards, while part ii of the book deals with such information as how to publish the cards, how to sell rights of reproduction, &c Those who have a fancy for printing their negatives in this manner will gain some useful wrinkles by carefully reading this guide

(3) Mr Mortimer describes another phase of camera work which is as useful to the amateur as the professional Mr Mortimer does not let the worker take much for granted for in these pages he refers to nearly every kind of subject that may be met with, from a flower study in a studio to the stoke-hold of a warship The value of the text is very much enhanced by some excellent illustrations indicating not only the relative positions of camera, subject, and flash-lamp, but the actual results produced in these circumstances

Beginners and others will do well to read this book, which embodies the results of one who has had a very wide and successful practical experience in this branch of the subject

OUR BOOK SHELF

The Rusts of Australia, their Structure, Nature, and Classification By D McAlpine Pp vii + 349, plates, 55 (Melbourne R S Brain, Government Printer, 1906)

THIS book is published by the Department of Agriculture of Victoria, and represents the labour of many years on the part of the Government pathologist (vegetable) The first part, up to p 75, contains much useful matter, although, of course, only a summary of the work of others The second part is also necessary and useful, but contains some serious blemishes

The author records sixty-three new species, the majority of which are more or less unsound, being simply forms of the same fungus growing on different hosts, and when, as on pp 160, 165, the hosts have been incorrectly determined, the fungi have been given incorrect names The author does not err alone in this matter, but the better botanists set their faces strongly against this practice of naming parasites according to their hosts without any experimental inquiry as to whether the same fungus might not infest many hosts, as in fact they do in many cases, and can probably be caused to do in still more The seventy two rusts recorded in Cooke's "Handbook to the Fungus Flora of Australia" are now increased to 161, but it is difficult to say to what extent this merely represents records of previously known species on new hosts In some cases the new species are supposed to be distinguished by minute differences in the shape and character of the spores Yet on Plate xl, p 320 are figures of abnormal spores of one species giving a greater range than that which in others makes new species A good instance of the confusion which arises from the system of naming is given on p 169 where four names are inextricably entangled, and the author solves this difficulty by creating a name of his own, and so making matters worse for subsequent investigators

The coloured plates are good, with the exception of Plate i, which is useless for fungal diagnosis There are far too many photomicrographs, a few give verisimilitude to a paper and confirm the *bona fides* of the author, but good hand drawings are always better for reference if they can be relied on

On the whole, there can be no doubt that the book is a useful one A few typographical errors, such as Schelhammera for Schelhammeria, are unavoidable in a work of this kind, but our author is mistaken in supposing that the Kew index is an infallible guide in questions of synonymy and in the naming of species It would have been better, both from the scientific and economic points of view, if the work on which the book is based had been more experimental and less taxonomic in character Probably the author felt that owing to the amount of ground to be covered only a general review of it

could be attempted, which should serve as a foundation for further detailed investigations of the important questions connected with these plant parasites

The Dissociation of a Personality, a Biographical Study in Abnormal Psychology By Dr Morton Prince Pp x+569 (London Longmans, Green and Co, 1906) Price 10s 6d net

OF all the problems raised by the investigations of that section of modern psychology which deals with the abnormal and neurasthenic, those concerned with what is called multiple personality are perhaps the most interesting for psychology and philosophy as a whole Cases of multiple personality are comparatively rare and this book is of great value as being a very full and careful account of quite the most remarkable of such cases known to us Dr Prince had "Miss Beauchamp" under his care from the time when a second personality first manifested itself until "the real Miss Beauchamp" was at length discovered and restored It is the great merit of the book that the author abstains almost altogether from theories These he promises us in a further volume In this he contents himself with a careful history of the details of the extraordinary case Extraordinary it certainly is There were three distinct and entirely different personalities Of these, two known as B I and B IV, were alternating, and only knew of each other by inference Dr Prince evidently considers that they were caused by "the splitting up the original personality" and loss of memory due to an intense mental shock Not the least interesting part of the book is an account of the striking oppositions in what we should be inclined to call bodily characteristics manifested by those two personalities But the personality known as B II, or "Sally," is most interesting of all Not only did she exist as an alternating personality with B I and B IV, but she went on being conscious all the time, while B I and B IV were in possession of the body, with the difference that in the one case she was conscious, not only of outside events, but of B I's thoughts, while in the other she was aware always of what B IV said and did but not of what she thought The consequence is that the study of Sally throws light on many questions concerning subconscious personality, and such phenomena as dreams, hallucinations, &c The questions raised by the whole story in regard to how a personality is constituted, and what either an associated or a dissociated personality can mean, are many and important, but a discussion of the philosophical importance of the facts recorded here had better be postponed until the appearance of Dr Prince's promised second volume Meanwhile, the book can be recommended to all interested in questions of abnormal psychology The facts of the case are told in a very direct and interesting way

A D L

The "Lloyd" Guide to Australasia Edited by A G Plate for the Norddeutscher Lloyd, Bremen Pp 469+ix (London Edward Stanford, 1906) Price 6s

THIS compact handbook on Australia should prove of great service to tourists visiting the Antipodes The volume is profusely illustrated, and generously provided with maps and plans Great care appears to have been taken in making the information up to date The volume may not only be commended to travellers, but also to teachers of geography in secondary schools, who will find it useful as a supplement to their class-books

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Presence of Neon in Radio active Minerals

I HAVE for some time been engaged in a search for the rare gases, along with helium, in the radio-active minerals The earlier results were negative, but I have just found a trace of neon in two minerals—zircon and cyrtolite I cannot give definite quantities but should guess that the neon is not so much as 1/300th part of the helium

The separations have been made by Sir James Dewar's charcoal method He suggested this application of the method in his original publication of it

I cannot yet state positively whether or not the presence of neon with helium is general The manipulation has been progressively improved, and it may be that on repeating the earlier experiments on other helium-bearing minerals neon will be detected On the other hand, it may be that the presence of neon is connected with zirconia, for both of the above minerals contain it

R J STRUTT

Sunnyside Cambridge

Radium and Helium

IN NATURE of October 25 Prof E Rutherford has briefly restated the arguments for considering that radio-active phenomena are probably associated with atomic degradation, and that as a rule the loss of an atom of helium accompanies such changes the atomic weight of the substance undergoing transformation being diminished by 4, the atomic weight of helium

With this assumption, the transformation of the uranium atom (238 5) into radium (225) occurs owing to the loss of *three* helium atoms whilst the change of radium into lead (206 5) is due to the loss of *five* such atoms The numbers are not however in strict agreement with this view for 238 5, $3\times4=226\ 5$ instead of 225, and $225-5\times4=205$ instead of 206 5

This objection can, however, be removed by assuming that the atomic weight of radium is not 225, but 226 5, for we then have

$$238\ 5-3\times4=226\ 5$$

and

$$226\ 5-5\times4=206\ 5$$

The above assumption, that the atomic weight of radium is slightly higher than that obtained by Madame Curie in her latest determination, does not, indeed, appear improbable when it is remembered that the first determination of the atomic weight of radium by Madame Curie gave a value of 146 and that the atomic weight has become greater and greater as the material used has been more and more purified Madame Curie now considers that her latest value is correct to within a single unit, but she states that the material she employed contained a minute quantity of barium

B WALTER

Hamburg physikalisches Staatslaboratorium
November 6

Magneto-striction

IN your issue of March 24 1904 Mr Nagaoka gives an account of a lecture experiment on magnetostriction, a few weeks later Prof W S Franklin describes an experiment of the same kind Both experimenters use a vertical solenoid along the axis of which is fixed at its upper extremity an iron wire When a current is sent through wire and solenoid, the wire is twisted The explanation given is that the wire is magnetised helically, the expansion along the lines of magnetisation resulting in a twist of the free lower extremity

May not the result of the experiment be accounted for in the following way? When a current enters at a pole and passes out at the centre of a freely suspended magnet, the magnet rotates about its axis If, then, the current enters at one pole and passes out at the other—as both halves tend to rotate in opposite directions—one end of the magnet should be twisted relatively to the other

D O S DAVIES

138 Earlham Road, Norwich, November 16

Photography in Natural Colours

IN NATURE of October 4 (p 571) you referred to the fact that the new method of photography in natural colours described by Prof Lippmann in the *Comptes rendus* of July 30 had been forestalled by myself and published in the *British Journal of Photography*, January 1, 1904 It is now my turn to disclaim priority, for Mr F Cheshire who wrote you on the subject before has just found, and kindly brought to my notice, a patent taken out by Mr F W Lanchester, of Alvechurch, dated 1895, which describes to all intents and purposes the same arrangement Not less curious is the fact that between the times of my own and Prof Lippmann's publications, another French investigator, M A Cheron, devised the same method and obtained a French patent for the same early this year, and another French worker M Raymond has according to M Cheron's communication to this month's number of *La Photographie des Couleurs*, been apparently working on the same lines

We have here, therefore the strange coincidence of five different people quite independently inventing the same method JULIUS RHEINBERG

16 Coolhurst Road, Crouch End, N November 24

ANTARCTIC EXPLORATION[1]

THE story of the Antarctic is longer in time than in materials, for the necessary existence of lands around the South Pole was affirmed by some of the earliest geographers There was abundant speculation about the character of these South Polar lands and the impossibility of reaching them before Bouvet found his islet and Cook was convinced of the existence of a great southern continent The Antarctic regions have furnished less dramatic incident and fewer commercial returns than the Arctic, but they have probably given, in proportion to the efforts devoted to them, more wide-reaching scientific results Dr Mill's book gives a full and graphic sketch of the whole subject It summarises the classical and mediæval speculations tells the narratives, and explains the results of all the expeditions that have worked in the Antarctic It handles the many branches of the subject—oceanography terrestrial magnetism topography and bibliography—with expert knowledge an intimate acquaintance with the scattered literature, and high literary skill The story is enlivened by pithy anecdotes and gives lucid explanations of the scientific problems, so that the book is as interesting as it is instructive It tells us for example of the cost of various expeditions Thus Cook's great results were achieved for 20,000*l* , and the *Belgica* Expedition gained its rich harvest for only 12,000*l* It helps us to place the explorers, by other incidents in their lives such as Dumont d'Urville's discovery of the Venus of Milo Maury's service in the Confederate Navy, Wilkes's achievements on behalf of the Northern States in the same war, and his famous arrest of the *Trent* The literary history is enlivened by many items of bibliographic interest, such as the mythical author "H M S Slaney," the recovery of the remarkable appeal to the Geographical Society in 1837 on behalf of Antarctic research by "A L ," from a French translation and the loss of Enderberg's MS in one of the London Society's libraries

The siege of the South Pole has been conducted by campaigns at three periods The first period began in the time of Drake, who reached 57° S lat and of de Quiros, who proclaimed his annexation "in the name of the Holy Trinity of all islands and lands which I have recently discovered and will discover even to the Pole " The great achievement of this period was the voyage of Cook, whom Dr Mill regards as the hero of Antarctic work He describes him as "the greatest of British maritime explorers, the one man who could be compared with Columbus and Magellan " He deplores that the only reward he received after his Antarctic voyage for "his stupendous service to science and his country, was a step in naval rank ", and he reminds us of the almost incredible fact that "Cook's own log was actually left unpublished for 130 years, while, incredible as it may seem, the description of some of the scientific collections of the voyage with the plates engraved at the time are only now appearing in the twentieth century " Cook's work showed that the Antarctic continent was confined within narrower limits than had previously been thought, but Cook, though he did not actually land on Antarctica, was emphatic as to its existence More definite knowledge of the Antarctic continent was obtained by the explorers of the second period that of Bellingshausen Weddell Biscoe, Wilkes and Ross It is to the work of that period that we owe most of the data that enabled Sir John Murray after the dredging of the *Challenger* had given the geological proof of the continental structure of the Antarctic lands, to prepare the outline map of Antarctica which as Dr Mill tells us, "subsequent discovery has not as yet materially modified " The active research of the second period was brought to a sudden and complete stop, the siege was raised for sixty years The abandonment of the work was perhaps partly due to the disgust at the quarrels in America over the Wilkes Expedition, and at the feud between Wilkes and Ross, but Dr Mill attributes it mainly to the concentration of attention in the Arctic, in consequence of the Franklin tragedy Ross's voyage naturally receives the fullest treatment, owing to its important results Great though they were they might easily have been greater for Dr Mill who has had personal experience of scientific research in naval vessels, remarks that "the average naval officer understands something of physical observations, but the collection of geological and natural history specimens is a mystery to him, and he abhors such mysteries ", and he describes how McCormick was hampered in his attempts to make zoological collections, and the misleading influence of Ross's theories, based on his mistaking records of pressure for deep-sea temperatures Had Ross's expedition says the author, "been organised on the lines subsequently followed on that of the *Challenger* the gain to science would have been enormous "

The third period includes the Antarctic research of recent years The long agitation for the renewal of the work is fully told by Dr Mill, from the appeal by Maury to the Geographical Society in 1860 and the persistent efforts of Neumayr, who was promised the leadership of an expedition from Hamburg in 1870 which was stopped by the Franco-German War, he records the "snubbed proposals " of the Australian colonies, the suggested Australian-Swedish expedition and the resumption of Antarctic research by the whalers, by Dallmann in 1873 the *Balaena* with W S Bruce in 1892 the *Jason* under Larsen and especially the *Antarctic* sent by Sven Foyn in 1894 to the Ross Sea These commercial enterprises re aroused the public interest in the Antarctic and led to the despatch of the British, German Belgian Swedish, and French expeditions of the opening of this century, the results of which are now in course

[1] "The Siege of the South Pole, the Story of Antarctic Exploration By Dr Hugh Robert Mill Pp xvi+455 with maps and illustrations (London Alston Rivers Ltd 1905)

'The Voyage of the *Scotia* Being the Record of a Voyage of Exploration in Antarctic Seas ' By Three of the Staff Pp xxiv+375 with three maps and numerous illustrations (Edinburgh and London Wm Blackwood and Sons, 1906) Price 21*s* net

of publication Dr Mill closes his volume with proposals for an international scheme of Antarctic research, to be undertaken with the help of an international committee, the functions of which he proposes should be advisory He recommends the use of three or four whalers and light motor-cars, but no balloons, the uselessness of which has been twice proved The actual organisation of the expeditions should be left to those responsible for the money, and he holds that "the price of a battleship would conquer all the secrets of the South, not without risk, but still with far less risk than in say ten years of football" The book is illustrated with an excellent map of the Antarctic regions by Bartholomew, by many photographs of the scenery and ice-forms, and an excellent series of portraits of the chief actors in the Antarctic field The frontispiece, an instructive picture of Antarctic ice, has been contributed by Prof von Drygalski

through the pack to the latitude of 70° 25′ S., and though several times beset, it escaped and returned to the South Orkneys Suitable winter quarters were found in Scotia Bay, on Laurie Island; a house and magnetic observatory were built ashore, and the winter spent in active work On the return of spring sledging expeditions explored the island and determined the Ordovician age of its rocks by Dr Pirie's discovery of Pleurograptus and Discinocaris in the slates of Graptolite Island

As soon as the *Scotia* could be freed from the ice it sailed for Buenos Aires for stores, &c., while Mr. Mossman, with five men, remained at the station to continue the meteorological work. The *Scotia* returned on February 14, bringing with it a party of observers sent by the Argentine Government, which had wisely undertaken to maintain the meteorological station, Mr Mossman remained to help the Argentine party during its first winter, and the

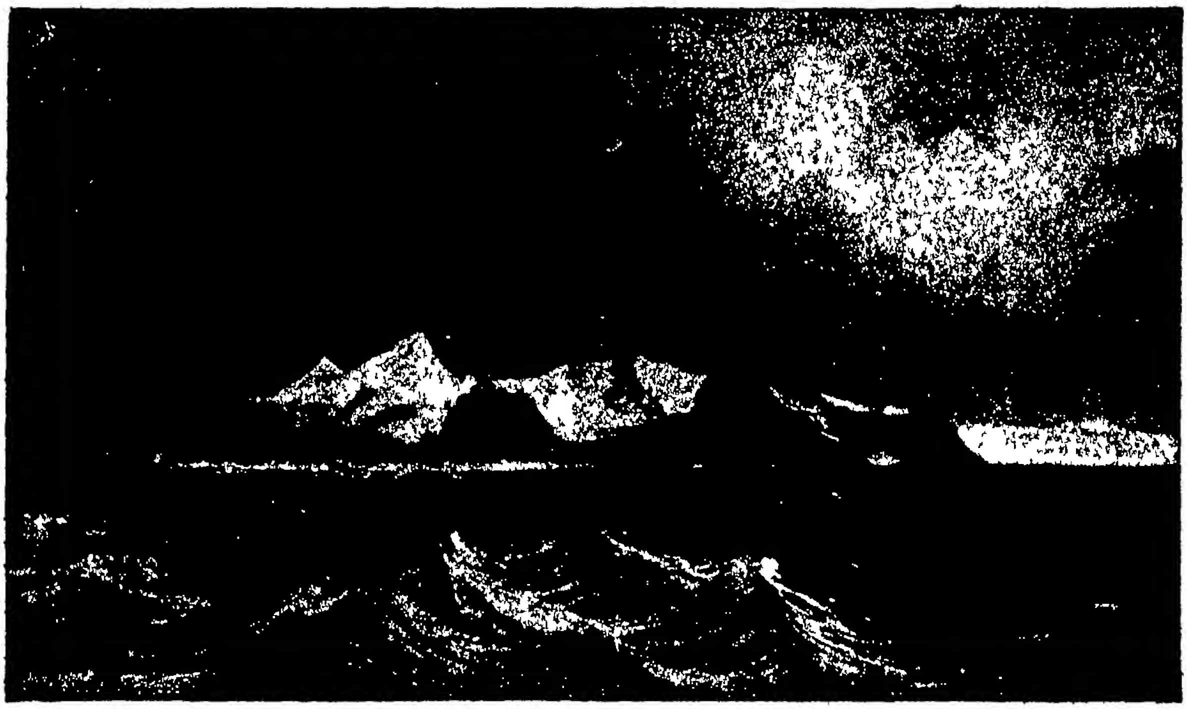

FIG 1—View of Elephant Island, one of the South Shetlands, in d'Urville's "Atlas From 'The Siege of the South Pole

The latest original contribution to Antarctic literature is "The Voyage of the *Scotia*," the narrative of the Scottish National Antarctic Expedition The expedition was organised and commanded by Mr W S Bruce, who after a voyage to the Antarctic in a Dundee whaler in 1892–3 had persistently advocated the despatch of an expedition to the Weddell Sea, and by careful training had rendered himself fit for its command He had made several visits to the Arctic, and from 1894 to 1896 had been in charge of the Ben Nevis Observatory, so that he was an expert in meteorological observation The funds available for the expedition were comparatively small, and were mainly due to the generosity of Mr Jas Coats, of Paisley The expedition left the Clyde on November 2, 1902, and the Falkland Islands on January 26, 1903. It was already late in the season, and the ice appears that summer to have been unusually thick in the Weddell Sea; but the *Scotia*, commanded by an experienced Arctic navigator, forced its way

Scotia left on February 21 with the rest of the Scotch expedition for its second cruise in the Weddell Sea

Here the expedition achieved its two great geographical successes It discovered a new land, Coats Land, which, judging from the boulders dredged off it, is composed of continental rocks, granite, gneiss, schist, sandstone, slate, and limestone This land is probably the edge of Antarctica, which therefore occurs 400 miles farther north than the position suggested for it on Sir John Murray's sketch map Murray had extended the Weddell Sea thus far to the south, as the natural inference from the reported soundings, which had been greatly exaggerated by Ross's primitive appliances Where Ross reported no bottom at 4000 fathoms, the *Scotia* found blue mud at the depth of only 2660 fathoms The *Scotia* has removed Ross's Deep from the chart During the return voyage the *Scotia* visited Gough Island, which was found to be volcanic, and after calling at Cape Town, Saldanha Bay, and various

Atlantic islands, it arrived back in the Clyde in July, 1904.

The narrative of the expedition is told by three members of the staff, Mr R C Mossman, the meteorologist and magnetic observer, Dr J H H Pirie, the medical officer and geologist, and Mr R N Rudmose Brown, the botanist Each author contributes the chapters describing the work with which he was most concerned The book perhaps suffers as literature from the difference in treatment of successive chapters, but it has the advantage of describing the whole expedition by the first-hand accounts of men concerned in all the different sections of the work

The narrative is of great interest It tells the story of long, thoughtful preparation, of the setting forth of a band of determined men, each well trained in his own line of work, and of their quiet, successful achievement of their purpose The expedition must be regarded, especially in view of its low cost, as remarkably successful Its discovery of Coats Land determined the hitherto quite unknown southern limit of the Weddell Sea, and has broken the longest unknown line in the coast of Antarctica As far as can be judged from published information, the *Scotia* will probably be found to have contributed more to Antarctic oceanography and biology than any of the expeditions in the field at the same time Its deep-sea equipment was excellent, and was fully used, and the description of the quantities of material obtained in the deep-sea hauls justifies the hope that the biological collections will yield most important contributions to our knowledge of the Antarctic fauna

J W G

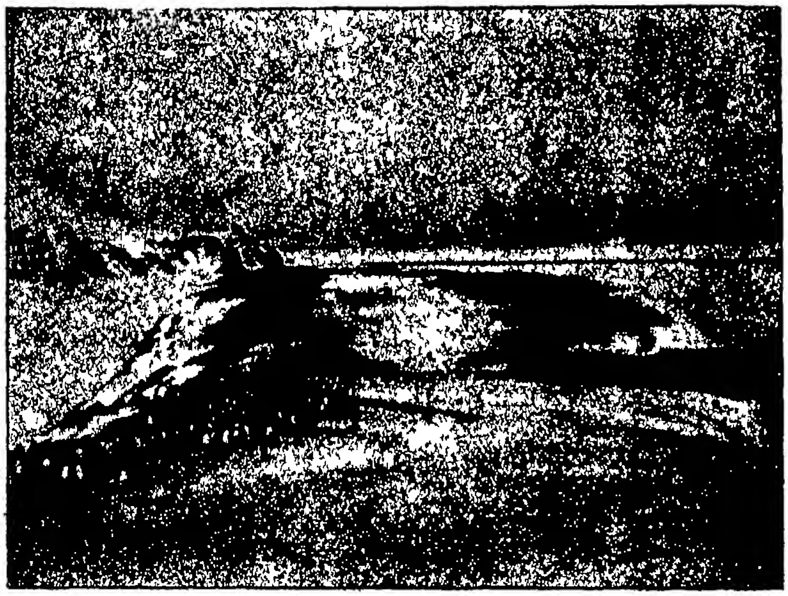

FIG 2 —Penguin rookery on Graptolite Island From "The Voyage of the *Scotia*"

SYNTONIC WIRELESS TELEGRAPHY

ON Tuesday evening, at a reception given by Lord Armstrong at the Queen's Hall, Sir William H Preece, K C B, F R S, being in the chair, a very important and interesting demonstration was given by Mr Valdemar Poulsen before a large audience, which included, among others, H R H the Duchess of Argyll, the Duke of Argyll, and the Danish Ambassador, of a new development of wireless telegraphy which affords grounds for hoping that the problem of syntonic signalling is at last nearing practical solution

Mr Poulsen will be familiar to readers of NATURE as the inventor of the telegraphone (see NATURE, vol lxii, p 371, and vol lxiv, p 183) Before describing the experiments shown at the Queen's Hall, it will be advisable to give a short account of the principles on which the new method is based It has often been pointed out in NATURE that all attempts hitherto made with regard to selective signalling are of a very unsatisfactory nature, and it has been suggested (NATURE, vol lxviii, p 249) that the solution is likely to be found in the application of the principle discovered by Mr Duddell in the "musical" or "singing" arc It is precisely that principle that Mr Poulsen has adopted The reason for this is sufficiently clear when it is considered that syntony, or tuning between transmitter and receiver, means the emission by the transmitter of sustained vibrations of definite frequency Only when these are produced is it possible to employ in the receiver a circuit tuned or resonating to this particular frequency

The main difficulty with all methods of spark transmission is to produce these sustained vibrations The signal produced by a spark discharge consists of a series of violent pulses each consisting of a short train of strongly damped vibrations of definite frequency Such tuning as can be done is accomplished by making the natural period of vibration of the receiving circuit the same as the vibration period of the individual pulses, but as the effect of the pulse itself as such is practically as great as that of its component vibrations, it will be readily seen that the tuning is only partial To make the syntonisation effectual, the effect of the pulse must be diminished and that of the vibrations increased In order to do this, the damping of the vibrations must be lessened until the signal is no longer a series of rapidly damped waves, but becomes a continuous succession of undamped, or, at the worst, very slightly damped vibrations, and the culminative effect of the continuous succession of waves will be far greater

The problem, therefore, reduces itself to the production of a train of undamped waves, and the manner of its solution was indicated by Mr Duddell when he discovered the phenomenon of the singing arc (NATURE, vol lxiii, p 182) Mr Duddell showed that if a continuous current arc, burning under such conditions that a small rise in the current is attended by a small fall of potential—or in symbols for which dv/dA is negative and numerically greater than the resistance of the shunt circuit—is shunted by a circuit containing self induction and capacity, there is spontaneously set up in that shunt circuit an alternating current the frequency of which is determined by the "natural" frequency of the circuit By the use of different inductions and capacities Mr Duddell produced alternating currents of various frequencies causing the arc to emit a musical note The frequency of these vibrations was, however, low—as is shown by the fact of the arc emitting a note—and in wireless telegraphy the frequency must be high Mr Poulsen has found that by burning the arc in an atmosphere containing hydrogen, by lengthening the

arc and by placing it in a strong magnetic field, the frequency can be enormously increased, and as many as a million vibrations a second may be obtained. Mr. Poulsen also finds that it is advantageous to have the anode of copper and the kathode of carbon, but when high currents are used the anode must be cooled by water running through tubes arranged for this purpose.

Mr. Poulsen showed several interesting experiments, illustrating the delicacy of the receiving circuit, in that on the slightest variation of frequency the activity of the receiving circuit ceases. Another experiment with a generator the oscillation circuit of which was connected directly to a resonator the frequency of which was in agreement with that of the generator circuit (about one hundred and seventy thousand oscillations per second), showed stationary oscillations with maximum tension at the top of the coil, and gave a peculiar soundless flame. As indicating the enormous amount of energy produced, Mr. Poulsen showed several experiments—lighting six incandescent lamps which were simply connected to a coil of wire which was brought near the oscillation circuit, destruction of a copper ring of wire when brought near, &c.

Turning to the transmitter used by Mr. Poulsen, there are two things of special interest, viz. the coupling and the signalling. As regards the coupling, the usual method employed is a very loose or close coupling, and the tuning is very sharp in either case. As regards the methods of signalling, various arrangements may be employed, but perhaps the most simple is by causing the key to short circuit a resistance periodically, which resistance must be large enough to reduce the amplitude and be included in the antenna-circuit. This method reduces sparking and permits of quick telegraphing. One may also telegraph by varying the tension of the magnetic field or of the feeding current, or altering the amount of hydrogen round the arc.

The receiving circuit for continuous waves includes an oscillation circuit with the least possible damping and in loose connection with the antenna-circuit. Owing to the continuity of the waves the detector may be arranged in such a way that it only intermittently forms part of the circuit of oscillation. Hence damping is avoided which the permanent inclusion of the detector would introduce. The apparatus which causes the intermittent contact is known as the "Ticker," and the usual material used for the contacts is either gold wire or German silver. Mr. Poulsen claims to be able to tune in practice to one per cent., and has received three messages simultaneously without mutual interference, the difference of wave-length in this instance amounting to three per cent.

Under the new method of undamped continuous waves Mr. Poulsen has sent a message from Lyngby, near Copenhagen, to North Shields, a distance of 530 miles, with a pole only 100 feet in height, for the expenditure of one kilowatt, and he hopes from this shortly to be able to get perfect communication across the Atlantic.

The chief advantages of Mr. Poulsen's system appear, therefore, to be:—(a) Extreme accuracy of tuning—thus ensuring selective signalling with no interference. (b) Freedom from interferences due to atmospheric electricity. (c) Greater efficiency due to accuracy of tuning and to the low potential of the electric surges impressed upon the aerial radiator.

Mr. Poulsen hopes that undamped and continuous wave-trains may yet be adapted to wireless telephony. The demonstration certainly proved that a great advance has been made in wireless telegraphy, and should the methods employed be brought into regular commercial use, there can be little doubt that Sir W. H. Preece's remark that probably the "death knell" of spark telegraphy has been sounded, will prove to be an accomplished fact. In the first place syntony will become a really practical affair, and interference troubles between neighbouring stations, which have to a certain degree been responsible for the necessity of international legislation, will disappear. Secondly, the cost of transmission will be diminished, as with undamped oscillations the energy used in transmission can be enormously diminished. For the same reason the effective distance over which messages can be transmitted will be correspondingly increased, and we may hope to see the real establishment of that Transatlantic communication so often announced and so often abandoned. J. L. M.

THE MARINE BIOLOGICAL ASSOCIATION AND INTERNATIONAL FISHERY INVESTIGATIONS.

LORD CARRINGTON, President of the Board of Agriculture and Fisheries, paid a visit to the Lowestoft Laboratory of the Marine Biological Association on Friday, November 23, in order to see the work which is being carried on at the laboratory in connection with the international fishery investigations in the North Sea. The principal features of the work were illustrated by means of a number of specimens and charts, which were explained by Dr. Garstang, the naturalist in charge of the laboratory, and by his assistants.

After being entertained at luncheon at the Royal Hotel by the council of the Marine Biological Association, Lord Carrington, who was accompanied by Mr. W. E. Archer, assistant secretary to the Board, visited the steam trawler *Huxley*, which carries out the investigations at sea.

Among those present to meet Lord Carrington were Mr. E. Beauchamp (M.P. for Lowestoft), the Mayor of Lowestoft, Mr. C. Hellyer (chairman of the committee of the National Sea Fisheries Protection Association), Mr. Deputy Sayer, of London, Mr. A. B. Capps and Mr. J. Jackman, of Lowestoft, and the following members of the council of the Marine Biological Association:—Dr. A. E. Shipley, F.R.S. (chairman), Prof. Bourne, Sir Charles Eliot, K.C.M.G., Dr. Harmer, F.R.S., Dr. Lister, F.R.S., Prof. D'Arcy Thompson, C.B., Dr. Chalmers Mitchell, F.R.S., Mr. G. L. Alward, Mr. J. A. Travers (treasurer of the association), and Dr. E. J. Allen (secretary and director), together with the members of the Lowestoft staff (Dr. W. Garstang, Mr. J. O. Borley, Dr. W. Wallace, Mr. R. A. Todd, and Mr. A. E. Hefford).

Under the present arrangement the scheme of international investigations terminates in July, 1907, but the council of the Marine Biological Association, in view of the importance of the work already accomplished, is urging His Majesty's Government to continue similar researches upon a more permanent basis. In this connection the following statement of the views of the council has been forwarded to His Majesty's Government:—

The council of the Marine Biological Association consider that the experience of the past few years justifies the opinion (1) that scientific investigations carried out on the deep-sea fishing grounds by means of a special sea-going steamer have produced results of great value concerning the biology of our food-fishes, (2) that a continuance of such experimental investigations is urgently required, in addition to the regular maintenance of market statistics and observations, in order to provide the exact knowledge necessary for the formulation of effective measures for the improvement of the supply of fish, and (3) that the advantages of international cooperation in

investigations extending over large areas are so great that it would be a decidedly retrograde policy that such cooperation should be abandoned. In support of the opinions expressed above, the council adduce the following statements and arguments with reference to sections (1) and (2) respectively, and believe that the statements will be fully substantiated in the detailed reports on the international investigations already published or in course of preparation.

(1) In conformity with the main object of British participation in the international scheme of investigations, as explained in the House of Commons by Mr. Gerald Balfour on June 12, 1902, and in accordance with resolutions of the International Council at Copenhagen in July of the same year, the investigations carried out in the North Sea by the association at the request of H.M. Government, have been largely concentrated upon the biological aspects of the undersized fish question, especially as concerns the supply of plaice.

By means of nearly 1000 hauls of the trawl the sizes of the plaice in different parts of the southern North Sea have been determined in detail and mapped out for different seasons of the year. The measurements of plaice recorded at sea on the S.S. *Huxley* exceed a total of 100,000. These investigations have clearly revealed the distribution of the various sizes of plaice in the English area during the period of investigation, and have contributed extensive material towards the collective report on this subject which is in preparation by the International Committee.

The causes which influence this distribution have been carefully investigated with respect to (1) depth, (2) nature of sea-bottom, (3) character of the food-supply, (4) growth, age, sex, and maturity, (5) locality of the nursery and spawning grounds, (6) seasonal migrations, (7) density of fish-population, and (8) intensity of fishing, and on most of these points definite results have been obtained.

By means of experiments with more than 7000 marked plaice the migrations of this species have been plainly traced in important areas, and much progress has been made towards the explanation of the observed movements.

The same experiments have furnished important results concerning the rate of growth in the chief parts of the English area.

An examination of the otoliths of more than 12,000 plaice caught and measured during the trawling investigations has yielded much new information concerning the age of plaice at different sizes on the chief fishing grounds, and has indicated a valuable method of controlling the results obtained from the marking experiments.

The marking experiments have afforded a new factor for estimating the intensity of fishing under modern conditions, and for measuring differences in this respect in different regions. In the case of medium-sized plaice (10–15 inches in length) we have found that out of 1100 fish of this size liberated at various seasons of the year in the southern area, where sailing trawlers predominate, approximately 30 per cent. have been recaptured within one year from the date of liberation, and that out of 400 fish similarly set free on the Dogger Bank and adjacent grounds, where steam trawlers predominate, about 40 per cent. have been recaptured in the same period.

The council regard these results as of great significance from a practical, as well as a scientific, standpoint, especially as there is reason to believe that the figures understate the full severity of the fishing.

Other results derived from the marking experiments and otolith investigations throw new light on the relative mortality of the two sexes, their habits of seasonal segregation, and their relative susceptibility to capture by the trawl, points which bear directly upon the problem of the effects of trawling upon the economy, and therefore the supply, of this species.

By the transplantation of large numbers of small marked plaice from the coastal waters to the Dogger Bank and other grounds, it has been found, during two years in succession, that the rate of growth is much greater on the Dogger Bank than on the nursery grounds, and the consideration of other factors renders it highly probable that the supply of fish can be profitably influenced by the transplantation of small plaice on a commercial scale.

A number of special experiments have been carried out on the *Huxley* to determine the vitality of trawl-caught plaice of different sizes. Owing to the variety of the conditions which influence the experiments, it is not possible at present to express these results in a single set of figures representative of average conditions, but the experiments support the opinions (1) that under commercial conditions of trawling on the nursery grounds a large proportion of the small plaice taken are mortally injured, and would not live if returned to the sea, and (2) that the beam trawl is less injurious than the otter trawl under similar conditions.

With respect to other food-fishes, such as cod, haddock, sole, turbot, &c., a complete register has been kept of the catch of the large commercial trawls on every occasion (between 900 and 1000 hauls), and about 250,000 measurements, exclusive of those of plaice, have been recorded. The information thus acquired has laid a broad basis of exact and trustworthy knowledge concerning the general features of the fish-populations of different fishing grounds, and concerning the size, weight, and to some extent the rate of growth of the various species represented.

This information has been supplemented by more than 700 experiments with fine-meshed nets and dredges for determining the character of the sea-bottom itself, the dominant features of the bottom fauna, and the distribution of the fish eggs and fry which escape the commercial nets. In particular cases experiments have been carried out on the migrations and rate of growth of marked fishes, especially of cod, sole, lemon sole, and latchet, and the relation of size to age in the case of cod and sole has been studied to a certain extent by means of otoliths. Extensive observations have been made upon the food of many species in different localities, and concerning their relations to one another either as prey, competitors, or enemies.

With regard to the hydrographic and plankton investigations specified in the international programme, the association has fully carried out its obligations in this respect by the most thorough and painstaking investigation of the waters of the English Channel. The results have been regularly forwarded for incorporation in the quarterly charts and records issued by the Bureau of the International Council, and have been reported on from year to year.

(2) In view of the fact that special research has been mainly concentrated hitherto upon the plaice, and that other valuable species present points of practical importance which still await solution, especially the sole, turbot, cod, and haddock, it is very desirable that the investigations which have been begun on these species should be continued and developed.

In this connection the council would point out that the necessity of scientific investigations has been generally recognised, whether such investigations be or be not carried out under a scheme of international cooperation.

While the council have indicated above the substantial progress which has been made with the experimental work at sea under their control during the past few years, they strongly urge that if this work should be brought to a sudden conclusion the prospective value of much preliminary labour and expense would be lost. Continuity of work is a factor of more than usual importance in experimental investigation of this character, not only because the conditions of the phenomena are constantly changing, but also because the extent and value of the results likely to be obtained are largely dependent on the experience of the staff employed.

NOTES

M. MASCART is retiring from the position of director of the Central Bureau of Meteorology in Paris. He will be succeeded on January 1, 1907, by M. Angot.

MR. L. A. PÉRINGUEY has been appointed to the directorship of the South African Museum, Cape Town, to fill the vacancy caused by the resignation of Mr. W. L. Sclater. Mr. Péringuey, who has been assistant director for some years, is a well-known entomologist and author of many papers on South African Coleoptera and other insects.

MADAME CURIE'S opening lecture to the students attending the course in general physics at the Sorbonne on November 5, on the subject of "Les Théories modernes relatives à l'Electricité et à la Matière," has been published in full in the issues of the *Revue scientifique* for November 17 and 24

DR E SYMES-THOMPSON, Gresham professor of medicine, and an authority on pulmonary diseases, died on Saturday, November 24, at the age of sixty-nine

SIR RICHARD FARRANT, who died on November 20 at seventy-one years of age, was treasurer of University College, London, which owes much to his business capacity It was largely due to him that the fund was started to raise 200,000*l* to provide for the necessary buildings and financial arrangements required for the incorporation of the college and the University of London, and his exertions in connection with the scheme will not readily be forgotten

THE New Zealand International Exhibition was opened on November 1 The exhibits are valued at three-quarters of a million sterling, and two thirds of this value represents industrial exhibits The exhibition is the largest that has ever been held south of the equator

THE winter meeting of the American Association for the Advancement of Science is to be held this year in New York City The first general session will be opened at Columbia University on the morning of December 27 The president of the meeting will be Dr W H Welch The sectional meetings will begin in the afternoon of the same day, and in the evening Dr C M Woodward, the retiring president, will deliver his address The meetings will be continued on December 28 and 29 and if necessary on December 31

VISITORS to the old Swedish cathedral and university town of Lund will find no little interest in the comparatively recent collections at the ethnographical museum illustrating many phases of rural life Old peasant houses have been taken down, brought from considerable distances, and set up at Lund, among the buildings being an old church and an inn Models of interiors of houses with costumed figures of inmates give an excellent idea of rustic conditions, reminding one, though on a smaller scale, of the Cecho-Slavonic museum in the Kinsky park at Prague No catalogue of the collections has yet been issued

IT is pleasing to note, from the current issue of its Bulletin, that the useful Société d'Encouragement, which is now in the 105th year of its existence, is in a satisfactory financial condition After several years of deficit, the accounts for 1905 show a substantial excess of income over expenditure The Bulletin contains useful summaries of recent progress in chemistry and mechanics, and affords clear evidence of the admirable work that is done by the society towards the development of the French national industries

THE Home Secretary received at the Home Office on November 22 a deputation of members of the Royal Commission on Coal Supplies, who asked that the records and estimates which they have prepared at great cost to the country should be kept up by the Geological Survey to prevent their labours from being almost abortive Lord Allerton believes that the whole of the information required could be had at a cost of 1000*l* or 1500*l* a year Mr Gladstone, while replying in sympathetic terms, pointed out that the Home Office is not properly equipped for cooperating with the work suggested, and he is afraid there may be difficulty in obtaining monthly returns. Lord Allerton, however, thinks that the difficulty is exaggerated, because, as chairman of a railway company, he has found that monthly returns can be obtained without increase of staff and without having to pay overtime.

IN connection with the fourth International Fishery Congress which is to meet in the City of Washington during September, 1908, a number of competitive awards has been arranged for the most important investigations, discoveries, or inventions during 1906, 1907, and 1908, relative to fisheries, agriculture, ichthyology, fish pathology, and related subjects The awards will be in the form of sums of money varying in amount from 12*l* to 50*l* The competition is open to any person, association, or company Papers may be written in English, French, German, or Italian The congress reserves the right to publish, prior to their publication elsewhere, any papers submitted in competition, whether such papers receive rewards or not The awards will be announced at a session of the congress All communications should be addressed to Mr Hugh M Smith, general secretary, United States Bureau of Fisheries, Washington, D C, U S A

AT the Institution of Mechanical Engineers on November 16 Mr Thomas Clarkson read an interesting paper on steam as a motive power for public-service vehicles The advantages of steam for public-service work were summarised as follows —the employment of a safe and cheap fuel, freedom from noise and vibration, absence of smell, and absence of change-speed gears, electric ignition, and friction clutch The maintenance cost of an engine that has been in regular public service on single-deck omnibuses for three years in Devonshire in 1905 was 6 23 pence per mile for total operating expenses, 1 5 pence per mile for tyres, and 1 16 pence per mile for depreciation Much has been done towards obviating mechanical stops and breakdowns during the past two years, and the steam omnibus of to-day is shown by Mr Clarkson to be a very satisfactory and trustworthy machine

IN the first article of the fourth number of the *Journal of Economic Biology* (vol 1) Prof A Nalepa, of Vienna, describes two "eriophyids" (Acari) from Fiji The first, *Eriophyes hibisci*, forms galls on a species of Hibiscus, of which the second, *Oxypleurites bisetus*, is also a denizen In the second article Mr G H Carpenter records the occurrence of larva of the chrysomelid beetle *Psylliodes chrysocephala* on cabbage-plants at Limerick Much damage was done to the cabbages on which the larvæ fed, but the author is of opinion that the occurrence is an unusual one, and that the normal food-plant of the species is different The third article is devoted to an account, by Mr R Newstead, of the life-history of the fly *Stomoxys calcitrans*, the larvæ of which are found in stables, cow-sheds, &c

IN vol xvii of *L'Anthropologie* appears an illustrated paper, by the late Mr E Piette, on evidence for the domestication or partial domestication of the horse (and possibly a wild ass) during the Reindeer epoch. This evidence consists of a number of sculptured and incised heads of horses invested with halters or head-stalls Some of these head-stalls, as shown in the figure of a head from the cave of St Michel d'Arudy, are of a very complex nature, consisting not only of several strands of rope, but of a piece of buck's horn or bone under the lower jaw The evidence seems to be conclusive as to the domestication of the horse

during the late Pleistocene epoch, and likewise demonstrates that, as might have been guessed, the head-stall is older than the bit.

THE cruciform brooches of Norway form the subject of a long article by Mr Haakon Schetelig in the second part of the "Bergens Museum Aarbog" for 1906 Prototypes of these ornaments occur in the peat of Nydam, and are believed to date from about 350 A D, and they are considered to have been introduced into Norway about the same time, since they are found there in graves containing weapons and implements of the Nydam type In a second article Mr O J Lie-Pettesen discusses the habits and etiology of Norwegian bumble-bees, more especially in connection with the powers of orientating their position and finding their way home The development of the crustaceans of the genus Sclerocrangon, and more especially that of *S ferox*, discovered in the North Atlantic by the Norwegian expedition of 1876–78, forms the subject of a communication by Mr Alf Wollebœk A striking resemblance exists between the development of Sclerocrangon and that of *Astacus fluviatilis*, which is remarkable considering the comparatively wide geographical separation of the two forms, and that one is marine and the other freshwater The concluding paper by Mr K Høye, deals mainly with the mould *Torula episoa*, affecting dried cod Tables are given showing the percentage of spores of this mould in various Norwegian localities, and measures are suggested for preventing its ravages on stores of the fish

LIEUT-COLONEL C D DURNFORD has a second paper on the flying-fish problem in the November number of the *Annals and Magazine of Natural History* As was noted in our columns at the time, the author in his original paper (published in the January issue of the aforesaid journal) endeavoured to prove on mathematical grounds that the "aeroplane theory" of the flight of these fishes was a physical impossibility, owing to the relatively small wing-superficies, and that consequently progression through the air must be due to intensely rapid wing vibration, aided in certain circumstances by movements of the tail, which in all cases give rise to the initial impetus In the supplementary communication Colonel Durnford adduces further evidence in favour of his explanation of the phenomenon Under average conditions, the chief features of the flight appear to be as follows —(1) the tail-impelled, visibly wing-assisted jump from the water to a height where the wings can work visibly, (2) the flight continued by an intensely rapid and laboured wing-movement, generally mistaken for a condition of rest, and, if seen at all, visible only as a blur, (3) short periods of slowing down of wing-movement, when the vibrations again become perceptible, (4) either sudden cessation of wing-movement, followed by an immediate drop into the water, or a short slow-down into visibility immediately preceding the immersion The result of careful dissection has been to demonstrate that flying-fish possess much greater development of the pectoral and caudal muscles than non-volant pelagic fishes of similar proportions

PROF C O WHITMAN has favoured us with a copy of an address (reprinted from vol v of the "Congress of Arts and Science, Universal Exposition, St Louis, 1904") delivered by himself on the problem of the origin of species It is argued that although Eimer's theory of orthogenesis and the mutation hypothesis of de Vries appear, respectively, to be contradictory to Darwin's natural selection, yet all three, in the professor's opinion may be reconciled Mutation may be admitted to be true in the case of the evening-primrose, but this by no means indicates that it occurs in most other instances On the contrary, the author affirms that he possesses conclusive evidence that species-forming variation advances in a definite direction (orthogenesis), although there are also variations advancing in different directions (amphigenesis) Orderly variation does not imply teleology, and the orthogenetic progress (of which we have an excellent sample in the development of the dark markings on the wings of pigeons) is the primary and fundamental one "In its course we find unlimited opportunities for the play of natural selection, escape the great difficulty of incipient stages, and readily understand why we find so many conditions arising and persisting without any direct help of selection"

ON the subject of the variations in the leaves of ferns grown in the sun or in shade, Miss J H M Ilroy publishes some notes on the leaves of *Nephrodium Filixmas* and *Scolopendrium vulgare* in the Proceedings of the Royal Philosophical Society of Glasgow, 1906 A marked difference was noted for two plants of Nephrodium with regard to the surface area of the leaves, that was twice as large in the case of the shaded plant as on the plant grown in direct sunlight, while the proportion was exactly reversed in the matter of spore output

THE Sea Island cotton produced in St Vincent continues to maintain its excellent quality Mr W N Sands, the agricultural superintendent, states in his annual report for 1905–6 that a considerable quantity realised nineteen and twenty pence per pound Owing to the refusal of planters in the United States to supply seed of this variety, St Vincent seed was selected to supply local needs and the requirements of other islands in the West Indies After cotton, cacao received the most attention, and nutmeg plants were also in request With respect to shade for cacao trees, the Madura *Gliricidia maculata* is preferred in St Vincent to Immortels, as being less liable to suffer from scale insects

MR E M FREEMAN, who has published previous papers on the fungus of *Lolium temulentum*, contributes a note on its affinities in *Annales Mycologici*, vol iv, No 1, showing that its continued existence in the grass is similar to the propagation of loose smut in wheat and barley Brefeld and Hecke have observed that a spore of the smut falling on the young ovary of these cereals can produce a mycelium, and later on spores from which germinating tubes pass into the developing embryo In Lolium spores are not formed, but the mycelium persists until the embryo begins to develop and then grows into it The author suggests that the evolutionary sequence in Lolium is later than that in the cereals on the hypothesis that spore formation has been prevented

THE "Agricultural Statistics of India for the Years 1900–1 to 1904–5" have been published in two volumes the first dealing with British India and the second with the native States The statistics have been compiled in the office of the director-general of commercial intelligence and may be regarded as a trustworthy record of the agricultural industries of India Running as the volumes do to more than 300 foolscap pages of figures, it is possible only to refer to one or two of the many interesting subjects included The tables dealing with the area under cultivation and total yield in the case of indigo show that from 1892 to 1900 the number of acres under cultivation was never under a million, and in 1894–5 was nearly a million and three-quarters During the same period the number

of hundredweights of indigo produced was never less than 112,000 and in 1894-5 reached 238,000 During 1905-6, on the contrary, the number of acres under cultivation fell to 381,000, and the amount of indigo produced to 45 000 cwt The case of cotton however is quite of a different character The number of acres under cultivation has steadily increased in recent years In 1899-1900 about 12 000 000 acres were planted, but during 1905-6 the number was well on the way to 21,000,000 The outturn in bales of 400 lb increased in a similar manner from 1 090 000 in 1899-1900 to 3 250,000 in 1905-6 The volumes certainly provide a rich storehouse of material for readers interested in Indian affairs

SEVERAL important papers appear in the October number of the *Journal of Hygiene* (vi, No 5) Dr Ashburton Thompson, President of the Board of Health New South Wales discusses the epidemiology of plague, particularly the part played by the rat and flea in its transmission, Prof Nuttall and Dr Graham Smith contribute an important and exhaustive account of canine piroplasmosis and of the morphology and development of the parasite *Piroplasma canis* Mr A T MacConkey describes the bacteriology of some cases of food poisoning which have come under his notice and Mr J D Thomson certain blood parasites of the mole An interesting instance of spirochatosis in mice is described by Mr C M Wenyon, and Dr Andrew Balfour gives some notes on herpetomonas parasites in fleas Finally the report of the commission for the suppression of ankylostomiasis in Porto Rico is abstracted The disease is very prevalent and probably 90 per cent of the inhabitants who number about one million suffer from it and are more or less incapacitated It is estimated that for an expenditure of 20 000*l* per annum 100 000 persons could be treated a year

IN the last volume of the Proceedings of the Institution of Civil Engineers (vol clxv session 1905-6 part iii) an account is given by Mr Baldwin-Wiseman of a series of investigations made by him during the last three years as to the relationship between the porosity of rocks and the flow of water through the interstices, under varying pressures A description and illustration of the apparatus employed also accompanies the paper The stones selected for experiment range from the Carboniferous to the Cretaceous rocks The stones were carefully selected and dressed into the form of cylinders 13 inches long and 6 inches in diameter These blocks were placed in a steel case and precautions taken to prevent any leakage The water was supplied from an hydraulic accumulator at varying pressures up to 75 lb on the square inch A drop of the piston which acted in the steel case of 1 centimetre was equivalent to a discharge of 62 06 cubic centimetres and the area exposed was such that a discharge of 1 cubic centimetre per second was equivalent to one gallon per hour per square foot of surface Special attention was given to the question of re soakage as bearing on the rate and amount of recharging depleted strata after a long-continued drought The results of the investigations are given in thirteen tables in the appendix to the paper where also there are two tables showing the geological formation, depth of wells, quantity of water pumped and other particulars of a large number of waterworks with details of the filter-beds

THE report of the Canadian Government Commission appointed to investigate the zinc resources of British Columbia and the conditions affecting their exploitation has been published by the Mines Department of the Department of the Interior (Ottawa, 1906) It forms a handsome volume of 400 pages, with numerous maps and illustrations In British Columbia the silver-lead ores occur in close association with zinc ore, which hitherto has proved a detriment to the value of the former The commission was appointed to arrive at a knowledge of the economic value of the zinc ores Mr W R Ingalls, an authority on zinc from the United States, was appointed to draw up the report, and Mr Philip Argall, of Denver, Colorado, and Mr A C Gardé, of Nelson, British Columbia, to act as his assistants Their report contains a vast amount of authoritative information on the mining and milling of zinc ores Some of the undeveloped zinc deposits of British Columbia are reported upon by Dr A F Barlow, of the Dominion Geological Survey The possibility of enriching the zinc ores of British Columbia to a high degree by magnetic separation is thoroughly demonstrated by the tests conducted by the commission In every case it has been possible to produce a zinc concentrate assaying upwards of 40 per cent of zinc and in some cases as much as 57 per cent of zinc Magnetic separators should be of the high intensity type, and means for roasting the ore are required The Blake electrostatic separator proved unserviceable for these ores which appear however, to be amenable to separation by flotation processes Electric smelting of the zinc ores is not advocated as this process must undoubtedly go through many stages of experiment before it can be pronounced a metallurgical and commercial success Smelting with Canadian coal is however quite feasible commercially Zinc ores are widely distributed and the situation is excellent for the creation of a zinc industry in British Columbia

AN interesting contribution to the study of pseudo-solution, dealing in particular with the colloidal forms of ferric hydroxide, is made by F Giolitti in two papers published in the *Gazzetta* (vol xxxvi ii pp 157 and 433) When ferric hydroxide, freshly precipitated by ammonia and thoroughly washed with water is examined microscopically it appears to consist of homogeneous gelatinous masses After being left in contact with water during several months, minute "nuclei" form in the gelatinous particles and on adding acetic acid the gelatinous portion dissolves leaving behind the nuclei" in the form of minute spheres of a nearly uniform diameter of about 7 μ These nuclei after being allowed to settle form with pure water pseudo-solutions which are characterised by being coagulable by dilute nitric acid A definite concentration of nitric acid necessary to produce coagulation corresponds to each concentration of the colloidal solution The pseudo-solutions of ferric hydroxide prepared by different methods have different physical and chemical properties, different solutions of the same concentration have for instance different absorption spectra With some solutions the addition of nitric acid causes the hydroxide to dissolve as nitrate, whilst with others a coagulation of the "hydrosol" is obtained With precipitated tungstic acid very remarkable phenomena are observed On washing the freshly prepared material very thoroughly with water, suspensions are obtained which after being left during several days, separate into a number of well-defined strata, differing in colour and degree of opalescence From these different strata pseudo-solutions can be prepared which at the same concentration have different limits of stability in presence of a coagulating agent such as nitric acid The explanation given of these phenomena is that the different pseudo solutions contain particles of different magnitude or molecular complexes

of a different character, the latter view appears necessary to explain the variation in chemical activity

IN the formula given in last week's NATURE (p 85) for converting Fahrenheit to centigrade degrees, the minus signs should have been plus, thus

$$C=(\tfrac{1}{2}+\tfrac{1}{2}\cdot\tfrac{1}{10}+\tfrac{1}{2}\cdot\tfrac{1}{100})(F-32)$$

Though the formula was incorrectly stated, the example given of its use showed plainly that a plus sign was intended.

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN DECEMBER —

Dec 3 3h. Jupiter in conjunction with Moon Jupiter 1° 58′ N
,, 10h 36m, to 11h 10m Moon occults ζ Geminorum (variable)
5 11h 15m Minimum of Algol (β Persei)
8 8h 4m Minimum of Algol (β Persei)
10–12 Epoch of Geminid meteoric shower (Radiant 108° + 33°)
9 6h Venus in conjunction with β′ Scorpii
13 2h Mercury and Venus in conjunction Mercury 0° 49′ N
,, 18h 1m to 19h 28m Transit of Jupiter's Sat IV (Callisto)
,, 19h Venus in conjunction with Moon Venus 2° 40′ S
15 Venus Illuminated portion of disc = 0 075, of Mars = 0 938
19 4h 40m to 5h 39m Moon occults γ Capricorni (mag 3 8)
,, 8h 32m to 8h 54m Moon occults δ Capricorni (mag 3 0)
20 13h Saturn in conjunction with Moon Saturn 1° 15′ N
24 3h 26m to 6h 26m Transit of Jupiter's Sat III (Ganymede)
25 Saturn Major axis of outer ring = 38″ 59, minor axis = 3″ 79
,, 10h 59m to 12h 12m Moon occults μ Ceti (mag 4 4)
28 3h Jupiter in opposition to the Sun
,, 9h 46m Minimum of Algol (β Persei)
30 8h 6m to 9h 37m Transit of Jupiter's Sat IV (Callisto)
31 6h 35m Minimum of Algol (β Persei)
,, 6h 41m to 9h 41m Transit of Jupiter's Sat III (Ganymede)

COMETS 1906*g* (THIELE) AND 1906*h* (METCALF) —Further observations of comets 1906*g* and 1906*h* are recorded in No 4134 of the *Astronomische Nachrichten* Prof Hartwig, observing at Bamberg on November 11, found that 1906*g* was of circular form with a diameter of 2′, having a central condensation 1′ in diameter and of the tenth magnitude On November 14 the condensation was very hazy and difficult to measure, whilst the total magnitude was about 9 0 Several sets of elements and ephemerides are published in the same journal, and the following is an extract from the ephemeris computed by Dr E Stromgren —

Ephemeris 12h M T Berlin

1906	α (true) h m	δ (true)	Brightness
Nov 30	11 8	39 1	
Dec 2	11 22	41 34	1 3
,, 4	11 38	43 59	
,, 6	11 54	46 14	1 2

Brightness at time of discovery = 1 0 (= mag 8 5)

The comet is now circumpolar, and apparently travelling in a line roughly parallel to, and south of, that joining ψ and χ Ursæ Majoris

Comet 1906*h* is so faint that it may only be observed with large telescopes

PHOTOGRAPHIC OBSERVATIONS OF GIACOBINI'S 1905 COMET —Some excellent photographs of comet 1905*c*, taken with the 10-inch Brashear doublet of the Yerkes Observatory by Prof Barnard are reproduced in No 4, vol xxiv, of the *Astrophysical Journal* That secured on December 29 1905 shows a great deal of structure in a tail 4½° long Joined to the comet's head by a narrow neck, this tail first broadens out and then narrows again its well-defined edges thus presenting a peculiar convex appearance The photograph taken on January 7, 1906, shows an even greater amount of structure a large number of thread-like strands diverging from a position about 1° from the head Although the tail of this comet was subject to great physical changes Prof Barnard considers that all the phenomena were due entirely to the solar action, there being no evidence of any outside distorting influence such as was suspected in the case of Brooks's comet (1903 IV)

SUN-SPOTS AND MAGNETISM —A retrospect of the stages whereby our present knowledge of the relation between sun-spots and terrestrial magnetism has been advanced at Greenwich is published in the *Observatory* (No 376) by Mr William Ellis For a long period Mr Ellis had charge of the magnetic observations at Greenwich and he describes steps of advance in which he took an actual part These observations were commenced at Greenwich and in several of our colonies, in 1840, and in September of the next year there occurred a considerable magnetic storm which was clearly shown to have commenced simultaneously in widely separated parts of the Empire thereby suggesting an external independent cause By the year 1852 General Sabine from a discussion of the collected results was able to suggest that this common cause was probably intimately connected with solar phenomena Mr Ellis proceeds to discuss the observations of both solar and magnetic phenomena, giving a number of direct references which should prove both interesting and useful to other observers

THE SOLAR ECLIPSE OF NEXT JANUARY —The Tashkent Observatory has issued a map of Turkestan showing the path of the moon's shadow during the total solar eclipse which will take place on January 13 1907 In the circular accompanying the map a series of meteorological observations is given, and these show that the prospects of a clear sky during the eclipse are not particularly favourable So far as is yet known three expeditions, one each from the Pulkowa and Hamburg Observatories and one from the Bureau des Longitudes are going to Samarkand (*Astronomische Nachrichten* No 4133)

NAKED-EYE OBSERVATIONS OF VENUS —In the November number of the *Bulletin de la Société astronomique de France* M A Benoit discusses numerous recorded instances of the crescent form of Venus having been seen by the unaided eye To determine the question of the probability of such an observation being possible a number of observations was especially made at the Juvisy Observatory during the period March–June 1905 Although on one occasion the observers thought they certainly saw the crescent subsequent examination with field glasses showed them to have been mistaken and from the complete discussion M Benoit concludes that this naked-eye observation is impossible

THE INTERNATIONAL CHART AND CATALOGUE —As the completion of the international scheme for charting the heavens is now within sight a correlated history of its inception and prosecution should prove of general interest Such an account is given in German, in No 48 vol v (new series), November 25, 1906, of the *Naturwissenschaftliche Wochenschrift* by Dr H Ludendorff and is illustrated by engravings of the instruments and a reproduction from a portion of one of the Potsdam plates

THE PERSEIDS, 1906 —In No 10, vol xxxv of the *Memorie della Società degli Spettroscopisti* Prof Zammarchi records the results of the meteor observations made on the nights of August 10–14 at the Vescovile di Brescia Observatory In all, 231 Perseids were observed and for the majority of these the paths brightness colour &c are recorded Many of the meteors left persistent trails and two of them apparently followed zigzag paths

RECENT EXPERIMENTS ON THE CRYSTALLISATION OF MINERALS

ALTHOUGH the crystallisation of alloys and of minerals must in its nature be essentially similar to that of the more ordinary solutions handled in the laboratory, the ranges of temperature and pressure involved are so far different as to make any experimental study a matter of considerable difficulty. In the case of the metallic alloys, the difficulties incident on the production and measurement of high temperatures have in recent years been overcome by the use of platinum-resistance thermometers, as in the investigation of the copper-tin alloys by Heycock and Neville, or by the use of thermal-junctions of platinum with a platinum alloy, as used so effectively by Roberts-Austen and his colleagues in the work of the Alloys Research Committee. As a result of these investigations, the conditions under which the different constituents separate from a liquid alloy, and the changes which occur as the solid ingot cools, are as fully known as the conditions which determine the separation of ice or salt from an aqueous salt solution.

The study of the crystallisation of an igneous mineral from a liquid magma has proved to be a task of very much greater difficulty. The temperatures of crystallisation are much higher, and frequently lie above the melting temperature of platinum; the minerals to be examined are not easily obtained in a pure state; they are poor conductors of heat and—perhaps the most serious difficulty of all—many of the minerals are so viscous when first melted that several minutes elapse before even the corners of the crystals become rounded; conversely, the melted materials often cool to a glassy mass and only reluctantly develop a crystalline structure. Difficulties such as these render almost inoperative the methods that have proved so effective in the study of metallic alloys; but new weapons have been provided by the perfecting of the radiation pyrometer as an exact method for the measurement of high temperatures, and by the commercial production of iridium melting at a temperature at least 600° above the melting point of platinum.

A quantitative study of the crystallisation of the lime-silica series of minerals has recently been published by Messrs. A. L. Day and Shepherd, of the Geophysical Laboratory of the Carnegie Institution of Washington (Journ. Amer. Chem. Soc., xxviii., pp. 1089–1114, September, 1906). The results they have obtained are so far in advance of anything that has previously been accomplished as to mark the opening of a new period in the development of experimental mineralogy.

Dealing first with the two pure substances from which this series of minerals is derived, it may be noted that lime melts at so high a temperature that it is not yet possible to make a satisfactory determination of the melting point; measurements can only be made with mixtures containing at least 20 per cent. of silica, and even these melt at temperatures ranging from 1400° to well over 2000° C. The melting point of silica lies below that of platinum, but the melting is so slow that when a charge of quartz was heated in an iridium crucible in an iridium tube furnace to the melting point of platinum (1709°) the grains did not coalesce, although they became tightly sintered together. Incipient melting could, however, be detected at a temperature nearly 100° lower, and the melting point is fixed by the authors at 1600° C.

Silica is a dimorphous compound, the two mineral varieties being known as quartz and tridymite. At temperatures above 1000° both quartz and amorphous silica change to tridymite. This is, therefore, the form which is stable at the melting point, and the melting temperature of silica is thus properly the melting temperature of tridymite, and not of quartz, as is commonly described. Occasionally by rapid heating quartz can be partially melted without inverting to tridymite, but it would hardly be possible by any known method to determine a separate melting point for unchanged quartz.

The converse change from tridymite to quartz is less easily observed. In presence of a catalyst, such as sodium tungstate, vanadic acid, or a mixture of potassium and lithium chlorides, amorphous silica was found to crystallise to quartz below 760°, and to tridymite above 800° by heating for five or six days the direct change of quartz to tridymite was proved at 800°, and from tridymite to quartz at 750°. The change is therefore reversible, and there is a true inversion point at about 800° C.

The melting-point curve for mixtures of lime and silica was explored by heating mixtures of definite composition, well mixed by grinding and repeated melting, on a platinum or (for higher temperatures) iridium strip, and noting the order of fusion. In this way two maxima and three minima were found, and these were subsequently investigated in such a way as to determine the exact composition and temperature at which each occurs. The maxima at 48 per cent. and 65 per cent. CaO correspond with the composition of the metasilicate $CaSiO_3$ and the orthosilicate Ca_2SiO_4, but no indication could be obtained of the separation from the melt of the compounds $2CaO.SiO_2$ or $3CaO.SiO_2$, or of the silicate $4CaO.3SiO_2$ analogous to the mineral akermanite.

Both the metasilicate and the orthosilicate are poly-

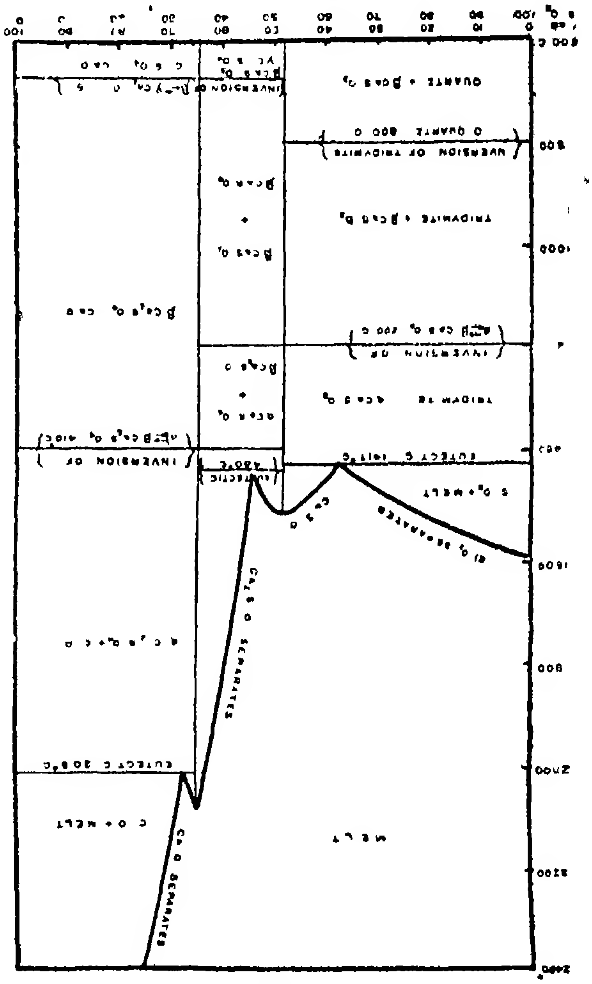

FIG. 1.

morphous. The metasilicate crystallises at 1512° in a pseudo-hexagonal form, and inverts at 1200° to a form identical with the mineral wollastonite. The orthosilicate crystallises at 2080° in a monoclinic α-form of density 3.27, and inverts at 1410° to an orthorhombic β-form of density 3.28, and again at 675° to a monoclinic γ-form of density 2.97.[1] The latter change involves an expansion of 10 per cent. in the volume of the substance, and is thus responsible for the disintegration or "dusting" of the orthosilicate and all mixtures containing more than 51 per

[1] It is unfortunate that the authors have reversed the convention which obtains in the case of iron, whereby the γ form is that which is stable at the highest temperatures, and the α-form that which is stable at atmospheric temperatures.

cent CaO. The orthosilicate is readily attacked by water, which dissolves out the lime in large quantities, this is probably the reason why it is not found as a natural mineral.

The three eutectics are —(1) tridymite+metasilicate, 37 per cent. CaO, 1417°, (2) metasilicate+orthosilicate, 54 per cent CaO, 1430°, (3) orthosilicate+lime, 67½ per cent. CaO, 2015°

Although the melting point of lime is unknown, the authors have been able to plot a complete diagram of the different equilibria that may occur in this series of compounds (Fig 1) The importance of such an achievement can scarcely be overestimated, and there can be little doubt that it will play as important a part in the development of experimental mineralogy as Roozeboom's classical diagram for the iron-carbon steels has done in modern metallurgy

T M LOWRY

CHARACTER AND CAUSE OF SUN-SPOT SPECTRA[1]

IT is now just forty years since the selective widening of Fraunhoferic lines in sun-spot spectra was first observed by Sir Norman Lockyer Since then various papers relating to the same subject have been published by Sir Norman Lockyer, Prof Young, and—more recently—Dr Mitchell and Prof Hale

The authors of the present paper state at the outset that in considering the chief features of sun-spot spectra, three points especially attract attention —

(1) The fact that certain lines in the spectrum of a given element are strengthened, others are weakened, the remainder being unaffected

(2) The occurrence of the strengthened lines in the visible spectrum only, none appear in the ultra-violet

(3) The relatively great intensity of the continuous back ground of the spot spectra in the less refrangible region

From what is known of laboratory spectra taken under varying temperature conditions, the following facts accrue —

(1) That in passing from a high temperature to a lower one, certain lines are relatively strengthened, some are unaffected, and others are diminished in intensity

(2) That such a reduction of temperature is accompanied by an increase in the relative intensity of the less refrangible lines, and a shift of the maximum of a continuous spectrum towards the red

The general correspondance of these two groups of facts led the authors to seek for an explanation of the spectrum of sun-spots on the hypothesis that the metallic vapours within the spots have a temperature lower than that of the photosphere

Photographs of spot spectra, made with the Snow telescope and a Littrow spectrograph of 18 feet (5 5 m) focal length, and showing a great number of affected lines, were available for the investigation The range of spectrum covered by these photographs is from D to Hδ Supplementary photographs of the spectra of recent large spots, extending from A in the red to the ultra-violet, have been obtained by Mr Ellerman

The laboratory work began with a study of iron and other metals in a synchronous rotating arc, designed and constructed by Prof Crew, but as the necessary photographs involved undesirably long exposures this was not continued It occurred to Mr Gale to try the effect of varying the current strength in an ordinary 110-volt direct-current arc, the difference of potential between the poles being kept approximately constant Photographs were taken, with currents of 30 amperes and 2 amperes, of the spectra of iron, titanium vanadium, chromium, manganese, calcium, and other metals characteristic of sun-spots As the work progressed, a correspondence was noted between the enhanced lines (lines stronger in spark than in arc) and those weakened in sun-spots To get further light on this, photographs were taken of the spectra of the same elements in the discharge of a 600-watt transformer, giving about 6000 volts at the secondary terminals A condenser was used in the discharge circuit, and the potential was increased by an auxiliary air spark in series with the observed spark, both being exposed to a strong blast of air from an electric fan Under these conditions the enhanced lines of the spark are well shown

The instrument used to obtain the majority of the laboratory photographs was a grating spectroscope in the Littrow form of 13 feet (3 96 m) focal length The Michelson grating has 700 lines to the millimetre In taking the comparison photographs of strong- and weak-arc spectra, two of the strong-arc spectra, with varying exposures, were generally placed on each side of the weak-arc spectrum From the four different strong-arc exposures thus obtained that one was selected which was most nearly comparable in general strength with the weak arc spectrum In some cases the spark spectrum was added, adjoining the weak-arc spectrum, with the strong arc spectra arranged as before

Tables are given in the paper which contain the results of a study of the elements titanium, vanadium, iron, chromium, and manganese for the region extending from the ultra-violet to λ 5800 The tables include all the lines which are affected prominently, and which, being strengthened or weakened in spots or in spark or weak arc as compared with strong arc, are of special importance in the investigation

In discussing the behaviour of the lines of the elements mentioned, the investigation is divided into two parts the relation of the weak arc to the strong arc, and of the arc to the spark Two sets of tables are therefore given The first shows the wave lengths of all the lines which are much affected in spots the amount by which they are affected their behaviour in the weak is compared with the strong arc, and in the spark as compared with the weak arc The second set of tables gives a comparison of the intensities of the lines of the same elements which are considerably enhanced in the spark with their intensities in the weak arc The majority of these which occur in the less refrangible part of the spectrum are weakened in spots, and such lines therefore appear in both sets of tables As, however most of the strongly enhanced spark lines occur in the violet and ultra-violet—where the spot lines seem to have the same intensity as the Fraunhoferic lines—independent lists of these lines have been added, since the evidence afforded by them as to the relation of spark to weak arc is extremely important

The authors summarise some of the results accruing from the investigation as follows —

(1) More than 90 per cent of the lines in the tables which are strengthened in sun-spots are found to be strengthened in passing from a 30-ampere arc to a 2-ampere arc

(2) More than 90 per cent of the lines shown by the tables to be weakened in sun-spots are weakened or absent in the 2-ampere arc

(3) More than 90 per cent of all the enhanced lines included in the tables are weakened or absent in the 2-ampere arc

(4) In a list selected at random of 152 lines which are not spot lines no cases were found of lines strengthened in the low-current arc

In discussing the temperature hypothesis as the probable explanation of the observed phenomena, some of the points made are —

(1) Waidner and Burgess's investigation of the temperature of the arc showed that the temperature of the crater was reduced 70° when the current was reduced from 30 to 15 amperes As the relative intensities of the lines undergo no material change in passing from 30 to 15 amperes while the change from 30 to 2 amperes is very pronounced, the temperature of the crater is probably considerably reduced at 2 amperes

(2) Since the enhanced lines of the spark diminish in intensity in the 30-ampere arc, and are still further reduced in the 2-ampere arc, no explanation hitherto advanced to account for these lines appears adequate in the present case, unless it be the explanation based on change of temperature

[1] Abstract of an advance proof from Mount Wilson Solar Observatory of a "Preliminary Paper on the Cause of the Characteristic Phenomena of Sun spot Spectra." (Contributions from the Solar Observatory No. 11) By George E Hale, Walter S Adams and Henry G Gale The paper is to be published in a future number of the *Astrophysical Journal*

(3) The behaviour in stars of the lines affected in sun-spots appears to be consistent with the view that temperature changes alone are sufficient to account for their variation in intensity (In this connection the authors formerly were inclined to the view that the presence of sun-spot lines in the spectra of red stars indicated the presence of many spots like those on the sun Recent work has led them to the opinion that the comparatively low temperature of these stars offers the simplest explanation of the observed phenomena The latter opinion had previously been arrived at and published by Sir Norman Lockyer in a paper "On the Relation between the Spectra of Sun-spots and Stars"[1]) In α Orionis—which from other considerations has been regarded as much cooler than the sun—lines that are strengthened in sun spots are still further increased in intensity, and in Arcturus, which is always assumed to be intermediate in temperature to α Orionis and the sun, the intensities of its lines have been shown by Mr Adams to agree remarkably with those observed in sun-spots

In an addendum to the paper an account is given of further work with (1) the flame of an ordinary arc, (2) a modified form of a Moissan electric furnace

It was found that the spectrum furnished by the flame of the arc—which is undoubtedly of a lower temperature than the core—showed changes of intensity similar to those observed with the 2 ampere arc and synchronous arc Comparison of the lines affected in the flame with those affected in the weak arc showed that, of the lines of Ti V, Cr, Fe, and Mn which were compared, nearly 90 per cent were affected in the same direction, and of these latter the same proportion were affected to a like amount Consequently a large majority of the lines strengthened in sun spots are relatively strengthened in the flame while those weakened in sun-spots are relatively weakened in the flame

The work with the electric furnace was done under conditions which the authors state, eliminated all possible electrical effects, and left temperature as the only possible agent for producing any variations in intensity of the spectrum lines Only Mn and Fe were investigated in this way but the resulting spectra again showed great similarity to the weak-arc spectra the majority of the lines being affected alike in the two cases

At the end of the paper a few objections which can be laid against the temperature hypothesis are touched upon

In a note added on October 2 an observation is included which seems to leave no doubt as to the comparatively low temperature of sun-spots At least one of the titanium flutings which occur in the flame of the arc has been clearly demonstrated to be present in two of the best spot-spectrum photographs

The work is regarded by the collaborators as being only at a preliminary stage but it is evident that it will with subsequent work on similar lines have an important bearing not only on the relative temperatures of sun-spots and photosphere but also on the temperature classification of stars

[1] Roy Soc. Proc, vol lxxiv p 53

ANTHROPOLOGICAL NOTES

TO the second number of *Bulletins et Mémoires de la Société d'Anthropologie de Paris* (ser 5, T vii, 1906) Lieut Desplagnes contributes an interesting paper on a little-known region of Central Nigeria, lying at the base of the plateau of Bandiagara (Banjagara), in the Massina district This lake region seems to have been inhabited from the earliest antiquity, and in the Polished Stone period to have supported a dense population at a high grade of civilisation to which numerous Megalithic monuments and a quantity of stone weapons and implements bear testimony, and long before our era examples of metal working, weaving pottery, &c, show the industrial stage to which the inhabitants had attained The character of the remains, physical and cultural, seem to suggest an Eastern origin for these early occupants who were probably related to the ancestors of the Galla-Somali peoples Later on, the nomad and pastoral peoples of the Sahara, attracted by the well watered pastures poured down from the north, and the tribes from the forests pressed up from the south, but all of these, though attaining right by might, had no aptitude for organised industry, and the primitive inhabitants were utilised as a sort of caste of workers, superior to slaves, but yet not mixing with the conquering clans In the smiths, weavers, fishers and potters, are found the descendants of the earlier owners of the land, while others maintained their independence by taking refuge in the islands in the river, the Sorkos, or in the surrounding mountains, the Habbès The paper deals chiefly with the Habbès, describing their traditions customs, habits, dwellings, industries, religious ideas, and sociology, in all of which they differ from their neighbours The illustrations give an idea of the character of the country and the people, and the photographs of the masked figures in the religious dances, supposed to represent the Spirit of the Ancestors, are of particular interest

L'Anthropologie, Tome xvii 1906, contains the first instalment of a study by Dr E. T. Hamy, 'Les Premiers Gaulois' Dr Hamy attempts to trace the physical characters of these invaders of northern Italy in the early Iron age from the evidence of the tumulus burials in France The evidence is unfortunately very scanty, but it is worthy of note that the skulls in the neighbourhood of the forest of Châtillon have a cephalic index ranging from 80 to 84 with an altitudinal index of 88 to 93, although one skull from Banges, in the same district, has an index of 73 1 This is followed by a paper by Mr Ed Piette, "Le Chevêtre et le Semi domestication des animaux aux temps pléistocènes, with many figures showing clear representations of halters in the engravings from the caves of Brassempouy, Mas d'Azil &c This communication forms the ninth in Piette's series of prehistoric ethnographic studies, and his last, for the volume ends with a notice of his death and a recognition of the great services which he has rendered to the science of prehistoric ethnography The second part of "Les Restes humaines Quaternaires dans l'Europe Centrale" by Mr H Obermaier, continues the useful summary of the evidence for Quaternary man in Europe The cautious tone of the writer is seen in the brevity of the list of human remains 'sûrement quaternaires' when compared with the list of, "Indications à écarter comme erronées douteuses ou insuffisantes"

In *Globus*, lxxxix, Nos 14 and 15, Mr Vojtěch Frič gives an account of his travels along the Pilcomayo—a tributary of La Plata—in Central Chaco with notes on the Pilagá and other Indians and illustrations showing the character of the country and the fine looking type of inhabitants Among the majority of these tribes it may be noted, the women propose marriage to the men the *modus operandi* differing among the different groups The method employed by the Pilagá women is to place a certain zigzag mark on a certain tree the chosen man presents himself, and no further ceremony is needed No 17 contains a description, by Dr Claus Schilling, of the Tamberma, who until a few years ago were an undiscovered people near the borders of Togo The illustrations taken by the author show the peculiar architecture and costumes of the district This paper is followed by a short account of another African people, the Mpororo of the north-west corner of German East Africa, by Oberleutnant Weiss Nos 18 and 19 of the same periodical contain articles on the Gold Coast negroes by the medical missionary Dr H Vortisch, who gives a review (with illustrations) of their physical features clothing character, family life, sociology political organisation, &c, and a careful record of their musical instruments, thirteen of which are figured Mr Erland Nordenskjold contributes an article to *Globus*, lxxxix, No 22, "Der Doppeladler als Ornament auf Aymarageweben," tracing the degeneration of the zoomorphic design through varying stages In a series of papers (in Nos 11, 20, 24, and xc, 1) Dr Theodor Koch Grünberg describes his travels "Kreuz und Quer durch Nordwestbrasilien," giving excellent pictures of the scenery and of the natives, with a map to show the linguistic grouping Of particular interest are the native drawings of animals In xc No 4, W von Bülow criticises the theories of Percy Smith, F Tregears,

and A. Krämer, on the origin of the Polynesians, and identifies Savaiki (Havaiki, Avaiki, Savaii, &c.) with Java, *i.e.* *sawah* (Javanese) = rice-field, and *iki* (also Javanese) diminutive suffix.

GEOLOGICAL RESEARCH IN SOUTH AFRICA.[1]

THE last number of the Transactions of the Geological Society of South Africa cannot fail to attract a greater number of geologists to follow the rapid progress being made in South African geology. This journal once threatened to be the dreariest; it is rapidly becoming one of the most interesting.

The visit of the British Association to South Africa has no doubt directed attention to the many points of interest in the geological history of one of the oldest land masses in the world.

Recent work between the Cape and the Zambezi has shown that the South African rocks present phenomena unparalleled elsewhere. The Dwyka Conglomerate undoubtedly affords the finest study of an ancient Glacial

This is a very well preserved striated surface of flagstone forming one of a series of such exposures at Blaauwbosch Drift. The striæ run from N.E. to S.W. The grey patches on the glaciated rock, which are only faintly shown in the photograph, are delicate Bushman chippings. The upper rock seen at the top right-hand corner is boulder shale. From "Transactions of the Geological Society of South Africa."

period. With this geologists have become familiar, but no more convincing examples have been found than those of the glaciated surfaces and boulder beds in Griqualand West described and beautifully illustrated by Messrs. Young and Johnson, but the Dwyka is not the oldest glaciation. Evidences of another have been obtained by Mr. Rogers from the Table Mountain Sandstone series, and he now describes a third and much older glaciation towards the summit of the Griquatown series. South Africa is thus yielding information on those points on which the older formations of the northern hemisphere are generally so persistently silent.

The unfossiliferous and lithologically similar pre-Cape rocks have of late years been proved to be built up of several unconformable groups. The number is added to in the present volume. They also contain rocks of a unique character, none more so than the remarkable Blink Klip breccia of the Griquatown series described by Mr. Rogers. This is a brecciated rock, exceeding 200 feet in thickness, formed by the collapse of the Lower Griquatown series into hollows dissolved out in the underlying limestones and dolomites.

That the interesting character of South African geology is not recognised to the full extent it demands is perhaps due to the overwhelming preference hitherto given to the economic study of the gold-bearing conglomerates and coal deposits. A utilitarian spirit still apparently holds a prominent place among several members of the Johannesburg school of geologists, of which an indication will be found in the present volume. Why, it is asked, is the Transvaal Survey engaged in the investigation of "outside" areas, where "outside" seems to include everything beyond the immediate vicinity of the golden city? Considering the number of ridiculously divergent opinions concerning the age, order of sequence and stratigraphical relationship of the gold-bearing conglomerates, it is evident that either the problem lies beyond solution or that the secret will be found in the outlying districts. That the enveloping movement around the Central Rand is being rapidly and systematically carried on is shown by the work of the Transvaal surveyors and by that of Mr. Rogers in Griqualand West. The results obtained by both surveys not only justify their existence, but warrant that in happier times, they will receive a more liberal help. The fuller knowledge so obtained can afterwards be applied to any special economic region with that nicety of attention to detail on which the success of applied geology so much depends.

W. G.

[1] Transactions of the Geological Society of South Africa. Vol. ix. January to April, 1906. Pp. 1–56. (London: Wm. Wesley and Son.) Price 15s.

THE SCOPE AND PROBLEMS OF PROTOZOOLOGY.[1]

PROTOZOOLOGY, a science that has only in most recent times attracted general attention, is nothing more or less than the study of a group of organisms which zoologists term protozoa, and therefore, in order to make clear the meaning and scope of the science, it is only necessary to explain, first, what the protozoa are, and secondly, why one should study them—to the extent, that is to say, of having independent university chairs for that purpose.

In sea-water or in the waters of lakes, rivers, ponds and ditches, in any small puddle or in damp earth and moss, in fact, in any situation where sufficient moisture exists to float their tiny bodies, protozoa can almost always be found, usually in abundance. If an infusion or liquid containing organic matter be exposed for a sufficient time to the air, protozoa will make their appearance in it and multiply. And, finally, there remains to mention a large but very important section of the protozoa which do not get their living in an honest and independent manner, but live as parasites of other animals and nourish themselves on the internal juices of their hosts; it may be in the digestive tract, or it may be in the blood, or in some other organ or tissue of the body. Thus the situations in which protozoa may be found show the utmost diversity of character. It must not be supposed, however, that every minute living thing which can be detected growing or moving in a moist environment is necessarily one of the protozoa. Here we have to draw some distinctions and to eliminate certain types of organisms. In the first place, the protozoa must on no account be confused with the bacteria, a group of organisms which stands sharply apart from other microscopic forms of life. Apart from the bacteria, the world of microscopic life can be further divided into two groups, the one comprising those of animal nature and habit, the other those more distinctly vegetable in their mode of life. The distinction between plant and animal, when applied to these lowly forms of life is, however, a most unnatural and artificial line of cleavage. It is impossible, therefore, to use vegetable or animal characteristics as a criterion for separating these minute organisms into natural groups. For this reason it has been proposed to unite all these primitive forms of life into one group

[1] Abridged from the inaugural lecture delivered before the University of London on November 1, by Prof. F. A. Minchin, Professor of Protozoology.

under the name protista, meaning literally the very first things, living things (zoa) being understood The protista would then rank as a separate *kingdom*, that is to say, as a category equivalent to the animal and vegetable kingdoms respectively

Theoretically, there can be no doubt that to group all these primitive living things together as protista is the most natural and proper way of dealing with them We should then talk of protistology rather than protozoology, and of a protist rather than of a protozoon which would at least be more euphonious But this method of dealing with these creatures is inconvenient and unsuitable in practice, chiefly because the group protista comprises such a vast array of organisms of different types that no one investigator can deal with them all satisfactorily, or with the different technical methods requisite for their study, and a division of labour has become necessary Hence the bacteria have been assigned to the domain of a special science, bacteriology the botanists claim for their sphere of investigations all those protista which are of vegetable nature, and there remain, finally, for the zoologist, those protista which can be regarded as *animals*, and which are therefore, termed the *protozoa*

We have now got so far, that the protozoa are minute, microscopic forms of animal life There are, however, many minute animalcules which are by no means to be considered as protozoa If we compare the protista with higher animals and plants, we find at once a fundamental difference In the body of a protist the living substance, the protoplasm, is not divided up into cells, but forms one simple mass, that is to say, the whole body of a protist is comparable to a single one of the cells that build up, in vast numbers, the complex body of a higher animal or plant Expressed briefly in the technical jargon, we may say that a protist is a unicellular organism, and that a protozoon is a protist of animal nature Since such organisms may be regarded as the most primitive types of animal life, the earliest, probably, to appear upon our globe, they have been named the protozoa, or "first animals"

We are now in a position to attack the second question that was suggested for consideration, namely, what is the interest and importance specially attaching to the study of the protozoa? This is a matter which can be considered most conveniently from two different points of view, the theoretical and the practical In dividing my discourse into these two heads, however I do not wish to be understood to imply that there is any real distinction between theoretical and practical science The whole history of human progress and culture shows that what is theoretical to-day is practical to-morrow This is such a commonplace that it would be superfluous to waste time by citing instances The theoretical knowledge of scientific principles must necessarily precede their application, hence to discover these principles is, even from the practical point of view, the most important occupation of the human intellect This is a point of view which cannot be too strongly emphasised, and to which I shall return again

From the theoretical point of view the protozoa are of the greatest interest on account of their primitive nature, and the light which they consequently throw on many obscure vital processes The cells which compose the tissues of higher animals have become extremely specialised for their particular functions and modes of life, and their structural or developmental characters tend to follow certain stereotyped patterns and to conform to uniform rules of procedure, due perhaps to a common origin and ancestry In the protozoa on the other hand each individual is an unspecialised cell, capable of performing equally well all the functions of life as a free and independent living organism, and the structural features or developmental processes of protozoa exhibit the utmost possible diversity of character Only by the detailed comparative study of this primitive diversity is it possible to discover the course of evolution which has culminated in the relatively uniform characters of cell-structure and cell-behaviour in the higher forms, and so to elucidate the true significance of many obscure cytological problems Just as the higher division of the animal kingdom may be reasonably supposed to have originated from protozoan ancestors, so the cytology of the higher animals may be said to have its roots in the cytology of the protozoa, and the same is perhaps true also of other subdivisions of biological science.

Turning now to the practical aspects and applications of protozoology, we find that these arise from the peculiarity already mentioned of many of these organisms, namely, that they live as parasites of other animals, and may produce diseases in them For this reason the investigation of the protozoa has, like that of the bacteria, become of immense importance to medical and veterinary science, and for this reason protozoology has taken shape as a definite science, and has gained recognition, outside zoological circles, just as bacteriology did before it Formerly it was always bacteria that were sought for as the agents of diseases Now it is known that many diseases are caused by protozoa, and not by bacteria, and it is suspected that this is the case also in certain diseases of which the cause is still obscure

Although, as I have stated, the practical importance of the study of protozoa has only been recognised generally in the last few years, nevertheless the actual discoveries of important disease-producing protozoan parasites date back, in some cases a quarter of a century Prof Koch of Berlin, has directed attention to three great discoveries, each of which opened up the way for a new line of investigation, and was of the utmost importance in establishing the true cause of diseases previously mysterious in nature The first was the discovery of the malarial parasites by Laveran in 1880 The second was the discovery of the parasites of the so-called Texas fever of cattle in America by Smith and Kilborne in 1893 The third was the discovery of the parasites of tsetse-fly disease in Africa by Bruce in 1895

The malarial parasite was first observed by Laveran then an army surgeon, in the blood of fever patients in the military hospital at Constantine in Algiers Though working with inferior microscopical apparatus, Laveran described clearly all the principal stages that can be made out in human blood This sensational discovery was received everywhere with coolness and disbelief At that time the cause of malaria was generally believed to be a bacterium, which was named *Bacillus malariae*, and it was some years before the bacillus was discredited, and Laveran's parasite established, as the true cause of the disease It still remained a mystery, however, in what way this minute organism got into the human blood, and the view was put forward that it gave rise to minute germs which passed out of the body and were scattered abroad, and which, like many other germs of protozoa, were able to float in the air It was supposed that those germs were then inhaled by healthy persons, and so gave rise to the disease This was simply an extension of the old miasma theory, the notion that the disease was contracted by inhaling the air of swamps and marshes, a notion expressed in the word malaria, meaning literally bad air It remained for a countryman of ours, Major Ronald Ross, to discover, by a series of brilliant experiments and observations, the part played by mosquitoes in disseminating the disease It was found, however, that a remarkable relation existed between the species of mosquitoes and the species of malarial parasites The common gnats, for instance, belonging to the genus Culex, are incapable of transmitting the malarial parasites of man but convey those of birds from one bird to another The mosquitoes which carry the malarial parasites of man belong to a different genus, Anopheles, and they in their turn are incapable of transmitting the malarial parasites of birds This is one of those remarkable adaptive specialisations so often seen in nature

Let us now follow the course of infection briefly If a mosquito bite a man suffering from malaria, it takes in a drop of blood in which are contained various stages of the malarial parasite The blood is, of course, digested slowly in the mosquito's stomach, and if the mosquito be a Culex all stages of the parasite are digested also but if the mosquito be an Anopheles, certain stages of the parasite resist digestion In the parasite of pernicious or tropical malaria, the resistent stages have a form like a sausage, and are known commonly as crescents These crescents undergo changes in the mosquito's stomach which give rise to sexual forms, minute, slender males, and relatively large, bulky females Fertilisation takes place

and the result is a slender, worm-like creature which progresses by gliding movements, and which penetrates into the wall of the mosquito's stomach, and there multiplies to form an immense number of very minute germs, producing a small tumour on the outer side of the wall of the stomach After a time this tumour bursts, and the little germs pass into the blood of the mosquito They are carried to and fro in the mosquito's blood circulation, but ultimately pass into its salivary glands, and the mosquito is now infectious When it next feeds, a swarm of the malarial germs passes down its proboscis into the puncture it makes, and in this way the disease is passed on from one person to another

The second important discovery mentioned above, that of Smith and Kilborne, concerns a fatal epidemic disease of cattle and other animals, sometimes termed red-water In this case the two American investigators discovered, not only the cause of the disease, but the method of transmission The parasites are tiny, pear-shaped bodies which penetrate the blood corpuscles and multiply there, so that two or more parasites may be found in one corpuscle Similar parasites are now known to occur in sheep, horses, dogs, monkeys, and rats, but are not known with certainty to occur in human beings

Smith and Kilborne discovered that the parasites of cattle red-water were transmitted by ticks, but not quite in the same way as malaria is transmitted by the mosquito When a tick feeds on an infected animal, it does not itself become infectious, but gives rise to offspring which are capable of infecting healthy animals, so that the parasite passes through two generations of ticks Unfortunately, nothing intelligible is known of the development of the parasite within the tick, and an important field of investigation is as yet untrodden

[For an account of the third discovery referred to above, that of Bruce, see NATURE, November 15 (p 56)]

Enough has been said, I think, to show that protozoology offers a most interesting and important field of investigation, of which as yet only the fringe has been touched Almost every day brings news of some new discovery in this field There are still, however, many questions to be answered relating both to protozoa and to the diseases caused by them, especially in the tropics, where insect life of all kinds is so developed, and there are so many different blood-sucking insects to carry infections of all kinds

This brings me now to the concluding section of my discourse—what are the problems of protozoology and how should they be attacked? The problems that present themselves to the student of the protozoa are principally of two kinds In the first place, there are purely zoological problems, such as the recognition, classification, and registration of the innumerable varieties and forms of these tiny creatures, the tracing out of their complicated life-histories and their bewildering changes of form and appearance during development, and the study of their vital processes and reactions to surroundings, as throwing light on many problems of cytology, heredity and evolution, of psychology and physiology In the second place, the results obtained by the zoologist—that is to say, by anyone working according to zoological methods—must be applied to the elucidation of questions relating to disease in man and beast, in other words, to the requirements of the healing art, as practised by the medical man and the veterinary surgeon Here, however, all the zoologist can do is to supply a knowledge of facts and principles of which the healer can make use, and the final beneficial result must be obtained by a collaboration of the investigator and the practitioner

Although it may be urged with justice that the most important outcome of human science is its application to human needs, it would be the greatest possible mistake to attempt to confine any scientific study to just those problems which are thought likely to yield results of direct practical importance Such a course would be short-sighted in the extreme, and would tend to produce a narrow outlook and a limited range of ideas, in the place of broad fundamental principles on which to base deductions for practical guidance Thus, to apply this statement to the special case of protozoology, the forms most important for medicine are those which are parasitic upon man, but it would be absurd to study only these forms, first, for practical reasons, because it is easier to experiment upon animals than upon our fellow-men, and, secondly, because the study of many different parasites and their development supplies analogies which throw light upon obscure points in the life-history of those attacking man But if we take a still wider view, we find that three-fourths at least of the protozoa are not parasites at all, but live free, independent lives in various situations

It is obvious, therefore, that to understand properly the highly-specialised parasitic protozoa we must be acquainted with the more primitive free-living forms first and foremost This conclusion may be illustrated by a few facts from the career of the late Dr Fritz Schaudinn, whose recent death at the early age of thirty-five was a most deplorable event, cutting off an investigator who, by his genius and industry, had won the very foremost place in the ranks of protozoologists The bulk of his work was done on forms not of importance from the practical that is to say, the medical, point of view, and yet it is not too much to say that his work has modified all our ideas upon the protozoa and has built up the modern conceptions of these creatures, so that no one at the present time can write upon them without taking into consideration the facts and principles discovered by Schaudinn, whose work is a living demonstration of the practical, as well as theoretical, imporance of non-practical scientific study

The physician and the zoologist work from points of view which, though apparently opposed, are in reality mutually helpful The physician, of course, takes the side of the patient, and his only object is to extirpate the parasite The zoologist, on the other hand, identifies himself as an investigator with the interests of the parasite and tries to become acquainted with all its migrations and changes, studying it for its own sake In short, the zoologist must deal with protozoa as if he loved them, but the medical man as if he hated them There can be no such thing as protozoology studied exclusively in relation to medicine Protozoology must be studied as a science in which all knowledge is helpful, directly or indirectly When the protozoologist has worked out his life-histories and obtained his results, then the medical man steps in and carries off the honey to the medical hive In this way by the cooperation of the purely scientific investigator with the practitioner, we may hope that protozoology may have before it a bright future, in which both theoretical science and the practice of the healing art may be advanced and benefited to an equal degree

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE —The Vice-Chancellor announces that the treasurer of the Cambridge University Association has recently paid to the benefaction fund of the University the sum of 904*l*, resulting from the appeal for the building fund for the new museum of archæology and ethnology This payment, together with 60*l* already received by the benefaction fund, is intended to form a nucleus of 1000*l* for the building fund of the museum The Vice-Chancellor publishes also a list of subscriptions, paid or promised amounting altogether to 12,325*l*, toward the building fund of the department of agriculture

After considering a resolution of the Classical Association in favour of abolishing the Greek grammar paper in the previous examination, the board of examinations proposes that in part i of the previous examination (*a*) the separate paper at present set on Greek and Latin grammar be discontinued, (*b*) the time allowed for the two papers on the Greek and Latin classics be increased from 2½ hours to 3 hours, in order that more questions in grammar may be set than at present, the questions in grammar to be such as arise from or are suggested by the passages given for translation, (*c*) the papers set on the alternatives to the Greek and Latin classics be similarly lengthened with the same object, and (*d*) these changes shall first take effect at the examination to be held in October, 1907

Sir James Dewar, who will be unable to lecture next term, has nominated Mr H O Jones, of Clare College as deputy for the Jacksonian professor of experimental philosophy during the Lent term of 1907 Mr Jones has

been re-appointed demonstrator to the Jacksonian professor until September 30, 1911

The Cavendish professor of experimental physics and the Lucasian professor of mathematics have elected Mr F Horton fellow of St John's College, to be Clerk Maxwell student in succession to Mr O W Richardson, of Trinity College who has resigned the scholarship

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THE treasurer of Guy's Hospital has received two anonymous donations of 200*l* and 10*l* respectively toward the fund for the endowment of medical education and research at Guy's Hospital

As part of the scheme of university courses in advanced zoology Dr W G Ridewood will deliver two lectures on "The Structure and Affinities of Cephalodiscus" in the zoological lecture room of University College Gower Street W C, at 5 p m on December 5 and 12 Admission to the lectures is free by ticket obtainable on application to the Academic Registrar University of London

IT has been suggested to provide a regularly equipped central station for lighting the buildings of the University of Sydney The work in this station might, it is thought, form part of the college engineering course In addition to work connected with the generation of power, the scheme would provide opportunity for testing for faults in mains, and for training in the commercial side of station work

THE Senate of the University of London has received from the Clerk of the Privy Council an intimation that the King in Council has approved the new statutes made for the management of University College and for the constitution and management of the North London or University College Hospital and the School of Advanced Medical Studies connected therewith All the arrangements made in connection with the incorporation of University College in the University will come into operation on January 1, 1907

THE University of California has been presented with the herbarium and botanical library of Mr and Mrs T S Brandegee of San Diego The herbarium *Science* states is one of the most important in the west of the United States since it contains something more than 100 000 sheets of carefully selected plants, mostly representative of the Mexican flora, which for many years has been Mr Brandegee's chosen field and of the flora of California and neighbouring States, which has received careful treatment at the hands of Mrs Brandegee We learn from the same source that the Academy of Natural Sciences of Philadelphia has acquired two important zoological collections One of these is the Gulick collection of Hawaiian land shells, which served as the basis of Rev John T Gulick's well known work "Evolution Racial and Habitudinal" and the other is the Tristram collection of birds numbering some 7000 skins and representing upwards of 3000 species This is the second collection made by the late Canon Tristram, the first one having been secured some years ago by the Liverpool Museum

THOUGH it was more common a few years ago there is still a disposition in some educational circles to refer to the study of the applied sciences as merely "bread-and-butter studies" In a recent address to the Wolverhampton Technical Schools published in pamphlet form by Messrs Longmans, Green and Co Prof Ripper has much of value and interest to say as to this contention He urges very rightly that these studies if properly pursued must develop scientific methods of thought and give new and higher interests to the student As Prof Ripper said "The same spirit which originally led to the study of technical science will tend also to the desire to travel beyond it The same qualities which have made the technical expert will tend also to make the enlightened and cultured citizen" The address concludes with an optimistic estimate of the educational outlook There is, Prof Ripper thinks, much more demand than formerly for technically trained assistants Employers are offering facilities for extended courses of study for their apprentices, for example several firms in Sheffield arrange for some of their apprentices six months' study at the university and six months' study in the works Employers, too, are immensely stimulating the work of education by making their appointments and promotions depend in an increasing degree upon educational fitness.

THE anniversary address of the Royal Scottish Geographical Society was delivered by Sir George Goldie, president of the Royal Geographical Society, on November 22 The subject of the address was "Geographical Ideals" Among a variety of subjects discussed in the address, great prominence was given to the question of the value of geography in war This value, Sir George Goldie said, might be best brought home to our own countrymen by recalling the enormous expenditure in which the want both of maps and of geographical training of our officers indirectly involved us during the Boer war He went on to say that he could speak confidently on these points from having served for nearly a year on the Royal Commission on the South African War He added that the lesson of the war in this respect has not been altogether forgotten During the last four years a certain amount of money has been expended in Imperial mapping of hitherto unsurveyed regions, and if this process is not altogether arrested by a spirit of false economy, we may possibly at some distant date possess fairly adequate maps of all British possessions Our ideal must be to reach the level attained by Japanese and German officers Sir George Goldie finally dwelt upon the importance of educating the people on the subject of geography and its removal from the subjects of the examinations for the Foreign Office and Diplomatic Service

THE report of the work of the department of technology of the City and Guilds of London Institute for the session 1905–6 is now available Statistics are given showing the continuous growth of the work of the department since 1879 The number of subjects in which examinations were held during the session under review was the same as in the preceding year but the number of separate classes increased from 2601 to 2820, the largest number recorded There was, too a marked increase in the number of students in attendance the number having risen from 41 618 to 44 464 At the examinations at the end of the session 20 610 candidates were presented in subjects of technology and of these 11 665 passed Numerous candidates were examined in India and the colonies We notice that Cape Colony Jamaica, Malta, Suez, Melbourne Granville (New South Wales) all presented candidates, but that the largest contingent of colonial candidates was that sent by New Zealand The system of inspection inaugurated by the institute grows in usefulness The inspectors appointed by the institute are men and women possessing somewhat different qualifications from those of the inspectors of the Board of Education and their work is supplementary to that of the Board Whilst the Board's inspectors report upon the general equipment of technical schools and upon the general character of the teaching those of the institute are concerned only with the special facilities provided for trade instruction, and report on the methods and the value of the teaching as part of the training of artisans

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 15 —Prof R Meldola, F R S president, in the chair —The determination of the rate of chemical change by measurement of gases evolved Preliminary notice J L F **Lamplough**. When a chemical reaction takes place in solution resulting in the formation of a gaseous substance, the solvent becomes supersaturated with the gas The excess of gas so dissolved may be almost entirely expelled by brisk agitation Under conditions of efficient stirring the rate of evolution of a gas furnishes an accurate and trustworthy method of investigating reactions —The formation and reactions of imino-compounds, part ii, condensation of benzyl cyanide leading to the formation of 1 3-diaminonaphthalene and its derivatives E F J **Atkinson** and J F **Thorpe**.—Note on the anhydride of phenylsuccinic acid F B **Dehn** and J F **Thorpe**. The authors conclude that the anhydride of phenylsuccinic acid exists only in one form, which melts at 53°–54° —Influence of sodium arsenate on the fermentation of glucose by yeast-juice Preliminary notice A **Harden** and W J **Young**. It has been previously shown

that the addition of a soluble phosphate to yeast-juice containing glucose increases the rate of fermentation, which proceeds until an extra amount of carbon dioxide (equivalent, molecule for molecule, to the phosphate added) has been evolved The phosphate at the same time undergoes a change which renders it non-precipitable by magnesia mixture When an equivalent amount of arsenate is substituted for the phosphate a similar acceleration is produced, but the rate is greatly increased, and continues for a time without change until many times the equivalent of carbon dioxide has been evolved, and then falls gradually —Xanthoxalanil and its analogues S **Ruhemann.**—Derivatives of cyanodihydrocarvone and cyanocarvomenthone A **Lapworth.**—Reactions involving the addition of hydrogen cyanide to carbon compounds part vi the action of potassium cyanide on pulegone R W. L **Clarke** and A **Lapworth** —The influence of various substituents on the optical activity of tartramide, part ii, P F **Frankland** and D F **Twiss** The authors have prepared and described the n and iso *propylamides*, the *allylamide*, the n- and iso *butylamides*, and the n-*heptylamide* of tartaric acid —The influence of various substituents on the optical activity of malamide P F **Frankland** and F **Done** The authors described the preparation and properties of the *methylamide ethylamide*, and iso*propylamide allylamide* and iso*butylamide* n-*heptylamide piperidide* and *phenylhydrazide* of ordinary *l* malic acid

Royal Meteorological Society, November 21 —The abnormal weather of the past summer and some of its effects W **Marriott.** The principal features of the weather over the greater part of England—especially the south-east—were the high state of the barometer throughout the whole of the period except a portion of August, the high temperature in July August, and September, the great amount of sunshine and the deficiency of rainfall Over the south-eastern portion of England more than 900 hours of bright sunshine were recorded during the four months June to September while at a few stations in the extreme south and on the east coast more than 1000 hours were recorded The sunshine was more than 200 hours above the average over the Thames basin and on the coasts of Lancashire and North Wales The most remarkable feature of the weather during the past summer was the exceptional heat wave which occurred between August 30 and September 3 The temperature rose above 90° over a large part of England on four consecutive days viz August 31 to September 3 With the advent of the hot weather the death-rate increased considerably and it was pointed out that when the mean maximum temperature for the week reached 72° the death-rate at once began to rise The increase of the death rate was made up almost entirely of infants under one year of age This was shown to be due to the prevalence of infantile epidemic diarrhœa which sets in when the mean maximum temperature for the week rises above 72° —The International Congress on Polar Exploration held at Brussels in September Dr H R **Mill**

Mineralogical Society November 13 —Prof H A Miers F R S, president, in the chair —Growth of crystals of soluble salts on each other T V **Barker** This paper is a continuation of the author's previous work on the growths of salts on isostructural minerals to those of soluble isomorphous salts on each other The group now investigated is that of the chlorides bromides, iodides and cyanides of Na, K, Rb, Cs, and Am which crystallise in the cubic system The view previously entertained that parallel growths are conditioned by a similarity of molecular volume is again found to hold good, some apparent exceptions are explained by the presence of isodimorphism One pair of salts however NaCl–KI, yield parallel growths although the molecular volumes are greatly different, this is perhaps to be accounted for by the fact that the molecular volumes are almost exactly in the ratio 1 2 —Notes on some Bolivian minerals I J **Spencer** Descriptions are given of crystallised jamesonite semseyite from Oruro, new crystal forms on andorite, chalcostibite from Oruro, augelite from Oruro sylvanite from Tatasi and Tasna, tetrahedrite from Huanchaca, regular grouping of stannite and tetrahedrite, valentinite, cassiterite, tourmaline and tourmaline-hornfels fluor, apatite, cupriferous miargyrite from Tatasi, crystallised miargyrite from Aullagas, jarosite from Chocaya chalybite from Chorolque and Tatasi, enargite from Chorolque —Note on ilmenite from Brazil G F Herbert **Smith** The crystals have three habits *cam camrX cuXrs*, differing slightly from those described from the same locality by Hussak The hemihedrism is shown by striations on the prism faces, some magnesium is present —Description of the Lengenbach Quarry and of the minerals found there in 1906 R H **Solly** The now well known quarry was opened about the year 1850 and various new minerals were described by Des Cloizeaux and others From 1860–70 a level was driven in a direction at right angles to the stream and in it were found the specimens described by Vom Rath In the decade 1890–1900 a little work was done each summer resulting in the specimens studied by Baumhauer Since 1900 Francis Jentsch and his partners have worked the quarry regularly each summer In 1902 they came across the old tunnel constructed in 1731 the existence of which had been quite forgotten Up to 1898 eighteen mineral species had been found, of which four are peculiar to the quarry since that date twenty-five additional species of which no fewer than twenty are new to science have come to light Nine of the new species have been named two are pseudomorphs and nine owing to paucity of material, have not yet been described The minerals found this year include trechmannite (fine crystals) baumhauerite (curiously striated and distorted crystals) seligmannite (a large crystal 20 mm in length) jordanite (a twin about 101) dufrenoysite (a twin about 001) pseudomorphs of dolomite and baumhauerite after scapolite (?) Note on the thirty-two classes of symmetry H **Hilton** Note on a Canadian mineral Prof **Harrington** Specimens of turnerite from Cornwall were exhibited by Mr **Russell**, and crystals of sartorite by Dr **Trechmann**

DUBLIN

Royal Irish Academy November 12 —Prof F A Tarleton president in the chair —The stability or instability of the steady motions of a perfect liquid and of a viscous liquid part 1 a perfect liquid Prof W McF **Orr** It is known experimentally that when water flows through a circular pipe the steady motion is unstable if the velocity exceed a limit depending on the radius of the pipe Lord Rayleigh has proved mathematically that in this case as well as in others of flow in plane sheets including that of a liquid which is shearing uniformly the fundamental modes of "free disturbance" are stable when viscosity is ignored in the disturbed motion the free periods being real There is thus an apparent contradiction between theory and experiment It is however contrary to the teaching of Fourier analysis to infer that a general disturbance is stable from the fact that the "free disturbances" possess stability, even of an exponential type In a system disturbed from equilibrium the question of stability is in reality decided by an energy criterion which is as a rule inapplicable to questions of the stability of motion If a liquid bounded by the infinite planes $y=0$, $y=b$ and shearing uniformly in the direction of x is subjected to an initial disturbance for which the stream function is $\psi=\sin lx \sin my$ it appears that, if mb and m/l are each large the disturbance, as shown by equations in which only terms of the first order of small quantities are retained increases in a great ratio as a certain time approaches after which it diminishes indefinitely A similar result is obtained for a symmetrical disturbance of simple type in a circular pipe when the steady motion is that of a viscous liquid When the steady motion is that of a viscous liquid between concentric cylinders one or both of which is rotating a similar result also holds for a two-dimensional disturbance (except the liquid rotates as a rigid body) It is held that these results afford an explanation of the observed instabilities as satisfactory as can be expected from an investigation which ignores viscosity A theorem on moving distributions of electricity Prof A W **Conway** The integrals which express the electric and magnetic forces for a moving distribution in terms of retarded potentials are discussed and it is proved that they obey Maxwell's equations outside the electrical matter, but that

inside the equations have to be modified by adding the convection current to the displacement current, as done by Fitzgerald.—The contact-phenomena at the junction of Lias and Dolerite at Portrush: Prof. G. A. J. **Cole**. The paper describes the microscopic characters of the rocks at and near the junction of Dolerite (or basalt) and calcareous Lias shale at Portrush—a junction of considerable interest in the history of geological opinion. The silicification of the shale is accompanied by the production of abundant minute crystals of a pale green pyroxene. The "bronzite" of Portlock and Oldham, named by them with some hesitation, proves to be a brown mica, locally developed after the formation of the pyroxene. The author has had the advantage of using the original specimens collected by Portlock's survey. Some details as to the later sheets and veins of dolerite are given, and the occurrence in them of differentiation, by gravitation of ferromagnesian minerals to their under surfaces, is compared with similar cases elsewhere.

PARIS

Academy of Sciences, November 19.—M. H. Poincaré in the chair.—The inflorescence of the seed-bearing ferns of the Culm and the Coal measures: M. **Grand'Eury**.—Observations of the new comet (1906g), made at the Observatory of Besançon with the bent equatorial: P. **Chofardet**.—Curves reproduced periodically by the transformation (X, Y, x, y, y'): S. **Lattès**.—A family of hyperelliptic surfaces of the fourth order: L. **Remy**.—A theory of magneto-optic phenomena in crystals: Jean **Becquerel**.—The heat of combustion and formation of some cyclic nitrogen compounds: P. **Lemoult**. From the experimental data given in this paper the author calculates the thermal changes in passing from nitro-compounds to oxyazo-compounds, from the latter to azo-bodies, from azo- to hydrazo-compounds, and from the last to amines.—The isomorphous crystals of lead nitrate and barium nitrate: P. **Gaubert**. A mixed crystal of lead and barium nitrates is not homogeneous, in spite of its transparence and limpidity; it is constructed of groups of pyramids the composition of which varies with the nature of the faces to which they correspond. The results are applied to the explanation of a similar structure frequently found in minerals.—The distribution of *Anopheles maculipennis* in the neighbourhood of Lyons: A. **Conte** and C. **Vaney**. The reduction in the amount of malaria in this region is much greater than would be expected from the slight reduction in the numbers of mosquitoes that has taken place in recent years. The possible causes of this are discussed.—The consumption of the glucose of the blood by the tissue of the mammary gland: M. **Kaufmann** and H. **Magne**. The experiments cited are all in favour of the theory of the transformation of the glucose into lactose in the mammary tissue in secretory activity.—Study of the variations of the mass of the blood in man: Gabriel **Arthaud**.—Chromotropism and its artificial inversion: Romuald **Minkiewicz**.—The stroma of the red corpuscles: MM. **Piettre** and **Vila**. A new method of separating the stroma is described.—Experimental researches demonstrating that anthracosis of the lungs is due to inhalation, and not to the deglutition of atmospheric dust: ——.—The presence of the spirochæta of Schaudinn in the testicle of a new-born syphilitic infant: Ch. **Fouquet**.—The fractionation of the rare gases in mineral waters: the proportions of helium: Charles **Moureu** and Robert **Biquard**.—The hydrology of the Bulgarian Dobroudja: M. **De Launay**.

DIARY OF SOCIETIES

FRIDAY, NOVEMBER 30

ROYAL SOCIETY, at 4.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Applications of Electricity in Printing works: P. A. Spalding.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Steam as a Motive Power for Public Service Vehicles (Discussion): T. Clarkson.

MONDAY, DECEMBER 3

SOCIOLOGICAL SOCIETY (Research Meeting), at 8.—Mating, Marriage and the Status of Women: S. S. Buckman.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Direct Estimation of Antimony: H. W. Rowell.—Bacterial Method of Investigating Disinfectants: M. Wynter Blyth.—The Determination of Solutions in the Analysis of Tanning Materials: Dr. J. Gordon Parker and H. G. Bennett.

SOCIETY OF ARTS, at 8.—Artificial Fertilisers: Nitrogenous Fertilisers: A. D. Hall.

TUESDAY, DECEMBER 4

SOCIETY OF ARTS, at 4.30.—The Cape to Cairo Railway: The Hon. Sir Lewis Michell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Talla Water-supply of the Edinburgh and District Waterworks (Discussion): W. A. P. Tait.—Repairing a Limestone-concrete Aqueduct: M. R. Barnett.—The Yield of Catchment areas: E. P. Hill.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Village Deities in Southern India: Lord Bishop of Madras.

WEDNESDAY, DECEMBER 5

ENTOMOLOGICAL SOCIETY, at 8.

SOCIETY OF ARTS, at 8.—The Metric System: Sir Charles M. Watson.

GEOLOGICAL SOCIETY, at 8.—On the Geological Conditions which have contributed to the Success of the Artesian Boring for Water at Lincoln: Prof. Edward Hull, F.R.S.—Notes on the Raised Beaches of Taltal (Northern Chile): O. H. Evans.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A Comparison of Values of the Magnetic Elements deduced from the British Magnetic Survey of 1891 with Recent Observation: W. Ellis, F.R.S.—The Theory of the Composition of Numbers, Part ii.: Major P. A. MacMahon, F.R.S.—On the Transpiration Current in Plants: Prof. Henry H. Dixon.—The Theory of Photographic Processes, Part iii., The Latent Image and its Destruction, an Abstract: S. E. Sheppard and C. E. K. Mees.—The Chemistry of Globulin: W. Sutherland.

CHEMICAL SOCIETY, at 8.30.—The Liquid Volume of a Dissolved Substance: J. S. Lumsden.—Some Derivatives of Benzophenone; Synthesis of Substances occurring in Coco bark (preliminary notice): W. H. Perkin, jun., and R. Robinson.—A Synthesis of Terebic, Terpenylic and Homoterpenylic Acids: J. L. Simonsen.

LINNEAN SOCIETY, at 8.—*Papers*: A Contribution to the Physiology of the Museum Beetle, *Anthrenus museorum* (Linn.): Prof. A. Ewart.—Note on the Origin of the Name *Chermes* or *Kermes*: E. R. Burdon.—*Exhibitions*: An Abnormal Specimen of a Dab with Three Eyes: Dr. A. T. Masterman.—A Note on *Siegesbeckia orientalis*, Linn.: Rev. H. Purefoy FitzGerald.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Selection and Testing of Materials for Construction of Electric Machinery: Prof. J. Epstein.

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THURSDAY, DECEMBER 6, 1906

VIVISECTION

Experiments on Animals By Stephen Paget Third and revised edition Pp xii+387 (London J. Nisbet and Co., Ltd, 1906)

THE new edition of Mr Paget's well-known book appears in time for the inquiry now being made by a Royal Commission on the subject of vivisection It is now exactly thirty years since the first Royal Commission on the subject of experiments on animals made its report A glance at this report is, to us of this generation, a revelation of the enormous progress that has been made in medical sciences during the last thirty years In the report the attention of the commissioners as well as of the witnesses, was almost entirely taken up with the question of physiological experimentation The leading men of the medical profession testified to the dependence of advance in medicine on advances in our knowledge of the workings of the body in a state of health, a proposition which must seem to every scientific man self-evident For the conversion to this view of the ordinary man, who does not think scientifically, the examples adduced by these witnesses must seem to us at the present time very scanty Again and again we have brought up in evidence the discovery of the circulation of the blood by Harvey and of the functions of the anterior and posterior roots by Bell and Majendie, and certain experiments on the growth of bone and on the absorption of ligatures in regard to their surgical application

Although the experiments of Villemin and Chauveau on tubercle are mentioned, the tubercle bacillus was as yet undiscovered Lister had already, for nearly twenty years, been endeavouring to discover the best method of prevention of wound infection, and had introduced antiseptics into surgery, but the antiseptic method had not yet been generally accepted Pasteur was still carrying out his researches on the nature of wound infection, but in 1878, three years after the Commission was appointed, his views had not yet received general acceptance Mr Paget gives a graphic description of a memorable discussion which occurred in this year at the French Academy of Medicine on the subject of puerperal fever In the middle of a long discourse by a doctor on the causes of this mysterious visitation, Pasteur interrupted with the statement that the epidemic was due entirely to microbes conveyed by the doctor and his assistants, and jumping up and going to the blackboard he drew the streptococcus on it, saying, "Tenez, voici sa figure." Bacteriology, in fact, was just being born, and few in this country had recognised the marvellous part it was to play in modifying the relations of man to his environment

From the development of bacteriology during these few years has grown the antiseptic and aseptic treatment of wounds, which is responsible for the saving annually of hundreds of thousands of lives, and for the practical abolition of pain from the surgical wards

The discovery of the tubercle bacillus by Koch has enabled us to deal successfully with numerous cases of tuberculosis in its manifold forms, "we have no longer to reckon with a nameless something, but with a definite parasite whose conditions of life are for the most part already known, and can be further studied" In this way we are in a position, in many cases, to shut off the sources of infection, and so to attain the prevention of this most fatal of all disorders

Since this time one disorder after another has been studied, and has given up its secrets to the bacteriologists The diphtheria bacillus was discovered in 1875, and isolated by Loeffler in 1884 In 1890 Behring and Kitasato discovered the antitoxin which is used throughout the whole civilised world, and has reduced the case mortality by one half

The tetanus bacillus was discovered in 1880, and the tetanus antitoxin by means of which we can protect against the disease though rarely succeed in its cure, in 1894 The horrible disease of hydrophobia was brought under our control by Pasteur in 1885 The cholera bacillus was discovered by Koch in 1883, and the method of preventive inoculation against this disease by Haffkine in 1893

The plague bacillus was discovered in 1894 Since this time, knowing the cause of the disease, it has been possible to track out its whole natural history, and the report of the last Commission on the subject has placed in the hands of the sanitary officials all the facts which are necessary for successfully coping with the disease

The typhoid bacillus was discovered in 1881 An emulsion of this bacillus is now constantly used in Widal's reaction, to diagnose typhoid and to distinguish it from other cases of continued fever Successful inoculations against the disease have been carried out by Wright

The discovery of the bacillus of Malta fever, or Mediterranean fever, by Bruce, has enabled medical men to determine the sources of infection of this disorder, and the resulting measures have this year caused a diminution of the cases from 258 in July, August, and September 1905, to fifteen during the corresponding months of this year,

The microorganisms of malaria and of yellow fever have been discovered and their life-histories worked out The part played by mosquitoes and gnats in the propagation of these diseases once having been recognised, it has been possible to wage a successful war against both these disorders Where preventive measures have been thoroughly carried out, these diseases, which previously decimated the population, have been practically stamped out I may mention here simply the case of Ismailia (malaria), Havana (yellow fever), and the Panama Canal (yellow fever) All these results, involving probably the saving of hundreds of thousands of lives yearly, have been accomplished by a science which has hardly attained its majority, and which is the direct outcome of the application of the scientific method for which a strong testimony was borne before the Royal Commission of 1875

These examples, though representing the results which can be most easily appreciated by the unlettered and unscientific, make up only a fraction of the benefits that have accrued to man as the result of the continuation of experiments on animals. The control of the bodily functions must be founded on a knowledge of those functions. Medicine must repose on physiology, or be reduced to charlatanism and empiricism.

During the last thirty years our knowledge of physiology has advanced all along the line. We can now form a mental picture of every event occurring in the heart throughout the cardiac cycle. We know the nature of the impulses and the course of the nerves concerned in the multitudinous adaptations of the circulation to every change in the environment of the body or of the activities of its different organs. We can form a connected image of the chain of processes concerned in the digestion of food during its passage through the whole alimentary canal.

The localisation of function in the central nervous system, to which in 1875 Ferrier had already contributed his remarkable experiments on localisation in the cerebral cortex, has now been extended to the whole nervous system. Though in such a complex system many paths must be still unknown, experiment has enabled us to unravel much of its complex character, and to form a clear conception of the possible paths open to almost any impression which may play upon the surface of the body. Comprehension of the coordination of movement, and of the processes involved in every movement of a limb, has only lately been revealed to us by the researches of Sherrington. An examination of medical literature shows us that the clinical physicians are alive to the close connection which exists between the study of disease and the study of physiology. Every new fact in physiology is tested with reference to the conditions in disease. Although in many cases the observations on man are too inexact to enable a complete utilisation of the facts of physiology, yet these clinical methods are being improved day by day, and the science of medicine is taking a larger and larger part as a guide to the practice of the art.

In his evidence before the Commission, Sir John Burdon-Sanderson expressed his profound conviction that "A future will come—it may be a somewhat distant future—in which the treatment of disease will be really guided by science. Just as completely as mechanical science has come to be the guide of the mechanical arts, do I believe and I feel confident that physiological science will eventually come to be the guide of medicine and surgery."

There is a danger that the striking utilitarian success gained by the pursuit of experimental investigations along certain definite lines may encourage the fallacy that any true distinction can be drawn between utilitarian and scientific researches. Even now a clamour has been raised by certain agitators for a restriction of experiments to those which can be shown to have a direct utilitarian object. Such a restriction is impossible. Science has taught us again and again that any increase in our knowledge must finally add to our powers. The so-called purely scientific researches are those dealing with general relations, and have as their object the discovery of laws which must affect our conceptions of the science in a number of its ramifications. It is the purely scientific researches which have effected the greatest revolutions in man's relation to his environment, and have placed within his hands the largest powers of control. Moreover, these researches must be undertaken in a spirit of pure curiosity, from a love of knowledge itself. The man who is always seeking a practical outcome for his experiments will have his field of vision narrowed, and the scope of his researches limited thereby.

The present Commission has been appointed largely as a result of an agitation on the part of those by whom every advance in science, and every change in the relations of man to his surroundings, are regarded as improper or even impious, and these persons, by misleading statements appealing to the better feelings of a credulous and unlearned public, have succeeded in arousing a feeling of resentment against those who are engaged in the advancement of the science of life by experiment. There can be no doubt that a marshalling by the Commission of the true facts of the case will show the slender grounds for the allegations made by the anti-scientific agitators, and will demonstrate the remarkable benefits to man attained during the last thirty years at the cost of the infliction of a trifling amount of pain on some animals.

It has been said, with truth, that the amount of pain inflicted in all the laboratories in this country in the course of a year is not equal to that suffered by the birds in one day's shooting *battue*, carried out, not primarily for food or for the benefit of man, but to amuse a few rich men. Yet noble "sportsmen" take a prominent place among the patrons and vice-presidents of the various anti-vivisection societies which, by leaflets and paid lecturers and letters to the Press, disseminate misleading and lying statements throughout the country in furtherance of their malignant campaign against science. Mr. Paget has been well advised in appending to this new edition a part iv., entitled "The Case against Anti-vivisection," in which he deals at some length with the unscrupulous methods of these societies and of their paid agents. It is sincerely to be hoped that the Royal Commission will inquire, not only into experiments on animals, but also into the morality of the anti-vivisectionists themselves.

E. H. S.

SENSE-PERCEPTION IN GREEK PHILOSOPHY

Greek Theories of Elementary Cognition from Alcmaeon to Aristotle. By John I. Beare. Pp. viii+354. (Oxford: Clarendon Press, 1906.) Price *12s. 6d.* net.

THIS volume, from the pen of the regius professor of Greek in Dublin, continues the kind of work so well begun for English readers by Prof. Burnet's "Early Greek Philosophy." It deals with the various theories entertained in regard to the five senses, sensa-

tion in general, and lastly the Sensus Communis, and its method is under each head to give as consistent a view as possible of what was severally taught by Alcmaeon, Empedocles, Democritus, Anaxagoras, Diogenes of Apollonia, Plato, and Aristotle There is little or no attempt to criticise these writers from the standpoint of modern philosophy But the statement is very clear, the discussion of disputed points scholarly, the facts are well arranged, and the literature—to judge from the footnotes and the list of books consulted—seems to have been thoroughly studied although one misses a reference to one recent work on the "De Anima"—that of Rodier, whose commentary, if not his translation, has been regarded by competent judges as indispensable.

As dissection was practised as early as Alcmaeon—he is stated to have been a pioneer in this direction—there is perhaps room for our wonder that the Greeks did not in their swift way attain some more consistent and conclusive theory regarding the working of the senses and the nervous system as a whole Possibly they were encumbered with the armour of pre suppositions with which they went forth to encounter nature—Empedocles and Anaxagoras with their respective doctrines that like is perceived by like, and contrary by contrary, Aristotle with his antitheses of form and matter, of *dynamis* and *energeia*, nearly all of them with a disposition—to which Aristotle, worse advised than Plato, succumbed—to regard the heart and not the brain as the physical centre of the intellectual life But at the same time one notes in this volume how little right we have to throw stones at them, *e g* how modern physics (to quote Prof Beare's words) "is as helpless to explain colour as physiology to explain olfactory function," or, again, that "the psychology of taste has advanced little beyond the popular and superficial stage at which Alcmaeon left it" Still, when all is taken into account, the final impression is one of admiration for the insight—which is genius—of an Aristotle, *e g* when "he rejected as if by anticipation the Newtonian emission theory of light", for the skill, too, with which he could produce a theory that would do justice to all the valuable elements in earlier philosophy, *e g* when he harmonised Empedocles and Anaxagoras by his statement that perception is a relation in which what was unlike becomes like

The occasional inconsistencies in Aristotle—those spots in the intellectual sun—are well discussed by our author Aristotle's views, or possible views, on biological development have always been a difficult, if interesting, subject, for in one passage of the "De Sensu" the master rejects Democritus's account that each of the other senses is "a kind of touch", but while Dr Ogle, on the ground of that passage, hesitates to credit Aristotle with the belief "that the remaining special senses are but modifications of touch or general sensibility," Prof Beare, on the other hand, finds it "hard to suppose that Aristotle—the pioneer, in *general* terms, of the theory of evolution not only physical but physiological and psychological—should in this particular application of his theory have failed to recognise it, or have denied its truth simply because it was a doctrine of Democritus" On every account this volume is to be commended to those interested in the development of theories of sense-perception

GRAVITATIONAL ASTRONOMY

The Collected Mathematical Works of G W Hill Vols ii, iii Vol ii, pp v+339, vol iii, pp 577 (The Carnegie Institution of Washington, 1906)

THE second and third volumes of Hill's works carry to 1890 the republication of his papers prepared for the American ephemeris and his miscellaneous writings The latter volume, which is entirely devoted to the theory of Jupiter and Saturn, is probably without parallel as a piece of calculation It is a splendid and enduring monument to ten years' incessant labour, and the nicety of agreement of its predictions with observation continues to justify the pains spent upon it It replaced Leverrier's theory, which was published while this was in course of production, and Hill found himself unable to point to any definite omission or flaw in Leverrier's theory which would account for the much inferior accuracy of its results, it seems to be due to accumulation of almost impalpable differences, and if some of Hill's work strikes one as over-elaborated, one can always look to the "Theory of Jupiter and Saturn" for justification

At the same time, one cannot help feeling in turning over some of these papers that to an adept straightforward calculation becomes an end in itself The memoir, No 48, on the lunar inequalities due to the spheroidal figure of the earth is an example This is entitled also a supplement to Delaunay's theory of the moon The theoretical additions are fairly obvious, and the main part of 143 pages is occupied with the steps required for determining 165 terms in the moon's longitude and 209 in latitude which are factored by the earth's ellipticity Not the fiftieth part of these terms reaches 0″ 1 in amplitude, and not the tenth of 0″ 01 Most people will regard this as more striking in its proof of the author's colossal patience than in any other quality

Probably no writer of the same originality has been content to follow his predecessors' models, upon occasion, so closely as Hill They owe him much The paper referred to above is the most elaborate application of Delaunay's method outside Delaunay's own work Hill's "Jupiter and Saturn" is the greatest monument in existence to the power of Hansen's methods, Hansen's own Lunar Theory not excepted It was to the problem of these two great planets that Hansen first made serious application of his methods in 1831 But, as Hill puts it, he "seems to have been carried away by the ambition of applying his method of treatment to the lunar theory," and never returned to it If anyone would disabuse his mind of the common misapprehension that Hansen's ideas are uncouth and his methods formless, and gain at the same time a concrete view of Hansen's method, he could not do better than follow out the steps of the *Auseinandersetzung* as applied by Hill Hill's modifications, few though important, are no obstacle The truth be-

comes patent that Hansen was a master of beautiful mathematical device. The bewildering detail ceases to obscure it when put into arithmetical form.

The problems of exact solution of the secular perturbations and of finding integrals of the equations of motion, which hold good for indefinite spans of time, must in the future occupy more and more attention.

Lately Hill has published an important memoir upon the subject (*Astronomical Journal*, vol. xxv.), two papers, Nos. 37 and 47, in the present volume show that his interest is not of recent date. No. 41, "Reply to Mr. Neison's Strictures on Delaunay's Method," shows him as a critic—a formidable though reserved antagonist not without ironic humour. No. 44, "On the Interior Constitution of the Earth as Respects Density," is a beautiful example of what he can do when working without the fetters of exact astronomy. Eventually the paper is a solution of the well-known equation for the density of a spherical aggregation of gravitating gas at constant temperature. The question had been treated before, but Hill's method is out of all measure more striking and complete than had been given previously.

NEOLITHIC MAN

Neolithic Man in North-East Surrey. By Walter Johnson and William Wright. With a chapter on Flint by B. C. Polkinghorne. Cheaper re-issue. Pp. viii+200. (London: Elliot Stock, 1906.) Price 3s. 6d. net.

THIS book is the result of several years of archæological investigation in the north-east corner of Surrey. The area visited measures about 14½ miles by 13 miles, it would fall between the Thames on the north and a line drawn between Boxhill and Oxted on the south. Within these limits the researches of our authors have been patient and unwearying, they have sought for traces of Neolithic man in field after field, on height after height. Set down in their pages is a large amount of information as to his homes (Worms Heath, Croham Hurst, Barrow Hill, &c.) and burial-places, as to his methods of work, agricultural and domestic, as to the food he ate and the implements he used, celts, hammer-stones, arrow-heads, scrapers, &c. Some space too has been devoted to his track-ways and fortifications, in most cases the same ground was occupied at a later period by Roman roads and works, or those of other invaders less skilled in engineering.

The main subject is prefaced by an account of the various inhabitants who have succeeded one another in this country, especially the Neolithic and bronze-using peoples, and by a survey of the geological features of Neolithic Surrey. Our authors are certainly right in holding that the "ages" overlapped or merged into one another, the terms "Stone, Bronze, Iron age" are, in fact, merely conventional; they can only be applied to the phases in development during which stone, bronze, or iron began to be worked, side by side with the material already in use, not of necessity replacing it. In Lancashire, for example, where the hills to the north prevented ready retreat in that direction, stone, bronze, and even iron seem to have been used contemporaneously at one period (see "Victoria County History of Lancashire"). Generally speaking, these opening chapters are highly instructive and accurate, they form a useful introduction to the story of Neolithic man. If they have a fault it is that they are perhaps a trifle too technical. Being a cheap re-issue, the present edition is obviously intended for the local student, to whom—not, of course, to the specialist—this preliminary information might be expected to be of service. In these circumstances the authors might have done better to leave out words like artifact, homotaxial, &c.; even geological terms like patina and Pleistocene, or at any rate to give their meaning. To leave them unexplained is to presuppose knowledge which is only too often to seek.

We have neither the space nor the necessary local knowledge to enter into a detailed criticism of the main subject. If we may venture a suggestion, we should recommend greater caution in the use of arguments based on etymology. We doubt very much whether all the authors' results (*e.g.* in chapter x.) would stand the scrutiny of a trained philologist. Only those who have made a special study of place-names are able to realise how dangerous and misleading this kind of evidence is apt to be.

There can be no question that the book is a valuable one. The extent of general knowledge displayed in it, and its high standard of scholarship, place its authors far above the ordinary run of local archæologists. Their work is only popular in the sense that it is inexpensive. In addition to the maps and illustrations by Sidney Harrowing and Frank Percy Smith, it has an index and a list of the authorities referred to in each chapter. Mr. B. C. Polkinghorne contributes a supplementary chapter on the constitution and alterations of flint, with reference to the subject of flint implements.

OUR BOOK SHELF

In the Days of the Comet. By H. G. Wells. Pp. 305. (London: Macmillan and Co., Ltd., 1906.) Price 6s.

THOUGH the actual collision of the earth with the head of a comet is an extremely improbable event, it is not beyond the bounds of possibility. In 1861 the earth passed through the tail of a comet; and the showers of meteors occasionally observed near the end of November are probably due to encounters with fragmental remains of Biela's lost comet. The disc-like appearance of Holmes's comet in 1892 gave rise to the suggestion that the comet was approaching the earth head-on, and we believe Mr. Wells then used the idea in one of his clever short stories. In any case he would have no difficulty in finding justification for the supposed collision with a comet which forms the *deus ex machinâ* of the present romance.

The comet which springs from Mr. Wells's imaginative brain is seen in its early days by an enthusiastic amateur astronomer who forms one of the minor characters of the story as a "quivering little smudge of light among the pin-points," while the spectroscope showed "an unprecedented band in the green." The unknown element which this peculiar green radiation

represented proves to be the Divine afflatus that lifts the human race out of selfish individualism into socialism understood in its finest sense The struggle for existence and the survival of the fittest no longer express operations of natural law, and the world becomes a place where the prevailing spirit is "all for all and each for each." Love is transfigured, hate perishes, war and all other manifestations of our animal nature are rendered unthinkable after the earth has passed through the comet The change which evolution can scarcely anticipate in the distant future is brought about in a single night

The idea is a noble one, and Mr Wells has dealt with the phenomenal and sociological aspects of the transformation in a masterly manner What is the destiny of the human race cannot yet be foreseen, but what man might become when "a new heaven and a new earth" have been created is a worthy subject of speculation, and when the theme is developed, as it is in this book, with scientific knowledge, prophetic insight, lofty purpose, and human sympathy, it almost persuades us that the gospel it conveys points the way to the millennium The message may not be understood, but the story in which it is presented cannot fail to excite interest and stimulate thought

The Elements of Chemical Engineering By Dr J Grossmann, with a preface by Sir W Ramsay, K.C.B, F.R.S Pp viii+152 (London C Griffin and Co, Ltd, 1906) Price 3s 6d net

It can scarcely be said that our system of technical education is satisfactory, so far as chemical technology is concerned Our technical colleges and universities turn out annually a large number of students who have received a fairly good training from the theoretical point of view, but have very little knowledge of apparatus or processes as conducted on the manufacturing scale It is obviously impossible for teachers who have not themselves been engaged in factories to teach chemical technology successfully Our German competitors have fully realised this, and some of the larger chemical manufacturers have combined and founded an institution specially devoted to the education of teachers, all the operations being carried out on the manufacturing scale In the absence of some educational establishment of this kind we must assume that the education of most of our students is defective from the practical point of view, and means must be found to convey the requisite knowledge before they can be entrusted with the supervision of manufacturing operations

Dr Grossmann's book has been specially written with this end in view, the object of the author being to make the student familiar with those factory appliances which are the equivalents of the apparatus used in the laboratory To render the comparison still more easy, the plant described is classified according to the supposed laboratory appliance which it represents. It is not always easy to ensure parallelism under such an arrangement, for instance, the chapter on "The Funnel and its Technical Equivalents" deals mainly with filtration, which is not the primary function of a funnel The remarks on the materials used in chemical engineering are practical, and will be of great use to students, whose knowledge on this subject is usually very defective

Among the useful features in which this work differs from similar manuals may be mentioned the price list of chemicals, which will be of great service to beginners, although, as Dr. Grossmann rightly remarks, the prices are liable to frequent fluctuations How great these fluctuations may be is shown by the fact that copper is now twice and antimony three times the price quoted in the list The price given for amyl acetate, 4l. 14s. 6d per lb, is evidently an error

As Sir William Ramsay says in his preface, the author has given a simple and lucid statement of the difficulties that a student may expect to meet with, and the book may be recommended as an introduction to the practical work of the factory

Crystal Gazing Its History and Practice, with a Discussion of the Evidence for Telepathic Scrying By Northcote W Thomas With an introduction by Andrew Lang Pp xlviii+162 (London Moring, Limited, 1905) Price 3s 6d net

The practice which gives its name to this book is only one of a number of devices which have been employed to assist the appearance of visual hallucinations Mr Thomas gives a popular account of the various methods which have been used in classical, mediæval, and modern times and describes the practices of various savage or barbarous peoples, such as the use of blood by the Maories and Pawnees, of quartz by the people of Sarawak, and of mirrors by the members of more advanced races

The subject has two distinct aspects One deals with the nature of the psychological processes involved in the appearance of the visions, and, treated from this point of view, crystal gazing is brought into line with other psychological processes such as visual imagination, hypnogogic and hypnotic illusions and hallucinations, &c

The other aspect deals with the question whether the visions of the scryer provide any evidence in favour of telepathy On this aspect Mr Thomas gives accounts from many sources, and concludes that, though fragmentary and unsatisfactory, the evidence is, on the whole, in favour of telepathic crystal visions It must be pointed out, however that his data provide perhaps equally strong evidence in favour of prophetic scrying The book has an introduction in which Mr Andrew Lang gives an account of the circumstances which first led him to take an interest in crystal gazing and of many experiments with which he has had to do Mr Lang regards his own ventures in this field as those of an amateur, and he appeals to professed psychologists to undertake the further investigation of the subject His own attitude however, is so eminently judicial that it is a matter for regret he cannot himself give more attention to this line of work, for the judicial mind is not too common either in the more academical or the more amateur students of this field of research

The History of the Collections contained in the Natural History Departments of the British Museum Vol ii, Separate Historical Accounts of the Several Collections included in the Department of Zoology Pp 782 (London British Museum, 1906) Price 30s

In this volume officers of the various sections of the Zoological Department have given accounts of the collections under their respective charge, tracing the evolution of each from small beginnings to its present condition Each account is complete in itself, but a remarkable degree of diversity is noticeable in regard to the amount of space occupied by the different histories, the notice of the bird collection far exceeding all the others in length At the end of each account is a biographical list of the various donors and collectors who have contributed to the section This involves a large amount of repetition, and some discrepancies are noticeable when the different lists are collated In many portions of the volume the editorial blue pencil might have been used freely with great advantage, and in some places the prolixity is so great that it is exceedingly difficult to winnow out the grain from the chaff Nevertheless, the volume contains a great mass of valuable information with regard to

the progress of natural history in this country and the evolution of the collections in the Museum which it would be very difficult, or impossible, to obtain elsewhere. Despite a lamentable loss of early collections, like those formed during Cook's voyages, owing to lack of knowledge of their value and indifferent curatorship, the Museum is particularly rich in type-specimens, more especially of species presenting well-marked characteristics of their own. In many cases particular attention is directed to these and other specially interesting specimens in the collection, although in these matters, again, a great diversity of treatment is noticeable in the different accounts.

Science and Religion. By the Rev. Lord William Gascoyne Cecil. Pp. 105. (London: Hodder and Stoughton, 1906.) Price 3s. 6d. net.

Five addresses delivered in substance at St. Lawrence Jewry during Lent, together with an explanatory foreword, make up the contents of this volume. The author lays claim to "no scientific qualifications at all," and therefore "can only speak as one of the crowd," to use his own description of himself. The sermons follow lines which are already familiar to students of science acquainted with the literature which has grown up round the attempt to "reconcile" traditional theology with results of scientific study.

How to Learn on Shore the Rule of the Road at Sea. By E. W. Owens. Pp. 40+23. (London: George Philip and Son, Ltd., 1906.) Price 3s. 6d. net.

This excellent little book meets a great want, and is strongly recommended for use in all training schools and ships. It is arranged in a convenient manner, and the explanations are simple and good. Part ii., which consists of extracts from the Merchant Shipping Act and the latest regulations for preventing collisions at sea, special lights for fishing craft, &c., makes the book not only useful in the class-room but a great convenience on the bridge of any ship as an *aide mémoire*. H. C. Lockyer.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Absorption of the Inert Gases by Charcoal.

It may interest some of your readers to know that Prof. Rutherford, in a private letter addressed to myself, has given a full explanation of the circumstances that led him to infer that the absorption of the inert gases by charcoal was exceptional. Fully appreciating the difficulties that beset Prof. Rutherford at the time he wrote the letter to Nature (vol. lxxiv., p. 634, October 25), I exonerate him from all blame in the matter, and willingly cancel all the expressions of regret he has been pleased to make.

With regard to the latent heat question, I ought to mention that Prof. Rutherford will not commit himself to the view that the electrometer readings recorded in the paper I quoted are proportional to the partial pressures of the emanation. He says:—"I do not know how far the electrometer readings may be taken as a measure of the partial pressures of the emanation, but naturally measurements over a range of temperature of 1° or 2° cannot be vouched for with any certainty." This would be a strong criticism provided any manometric measurements had been attempted, but if the electrometer measures directly the relative concentration of the emanation in a given volume of gas, the method is so sensitive that the increase caused by a narrow range of temperature is less liable to error. It is clear, however, that new determinations will have to be made before the question can be settled.

In the meantime, I can only wish Prof. Rutherford success in the applications of charcoal to the study of the emanations of radio-active bodies, and take the opportunity of expressing my gratification at seeing charcoal becoming of such scientific utility in the hands of workers like the Hon. R. J. Strutt, the French chemists Moureu and Biquard, not to mention others; the more especially as my own labours have been interrupted for reasons given in my former communication.

James Dewar.

Royal Institution, 21 Albemarle Street.

Radium, Actinium, and Helium.

In Nature of November 29 Dr. B. Walter discusses the theory of Prof. Rutherford that in radio-active change accompanied by the emission of an α particle the atomic weight is diminished by 4, the atomic weight of helium. According to this assumption, the transformation of uranium (238·5) into radium (225) is due to the loss of *three* helium atoms. Now uranium gives one α particle in changing to uranium X, so that only two such changes remain for any subsequent transformations. If we accept the result of Profs. Moore and Schuldt (*Phil. Mag.*, October) that uranium X gives out α rays, two changes are accounted for, and only one is left for intermediate products.

In Nature of November 15 Mr. Boltwood brings forward experimental evidence in support of the view that actinium is an intermediate product between uranium and radium; but in the case of actinium and its derivatives four changes, accompanied by the emission of α particles, occur. Thus, on the assumption that the α particle is a helium atom, there is no room for these products.

The difficulty can be removed by adopting another alternative, suggested by Prof. Rutherford, that the α particle is *one-half* of the helium atom carrying a single ionic charge (*Phil. Mag.*, p. 366, October). In this case we should have the following series possible:—

Series I.	*Series II.*
Uranium (238·5)—α	Uranium (238·5)—α
Uranium X (236·5)—α, β, γ	Uranium X (236·5)—α, β, γ
Actinium (234·5)	Unknown (234·5)—α
Radio actinium (234·5)—α	Actinium (232·5)
Actinium X (232·5)—α	Radio actinium (232·5)—α
Actinium emanation (230·5)—α	Actinium X (230·5)—α
Actinium A (228·5)	Actinium emanation (228·5)—α
Actinium B (228·5)—α, β, γ	Actinium A (226·5)
Unknown (226·5)—α	Actinium B (226·5)—α, β, γ
Radium (224·5)	Radium (224·5)

If the atomic weight of radium were 226·5, the unknown change accompanied by the expulsion of an α particle must be removed from the series. One or more rayless changes may also occur.

It is interesting to note that the atomic weight of actinium, according to Series II., comes out as 232·5, that is exactly the atomic weight of thorium. These two substances closely resemble one another in their radio-active properties, giving transformation products of very similar character. This suggests as an analogous case the similarity between nickel and cobalt, two elements of practically the same atomic weight. H. S. Allen.

King's College, London, November 30.

Mira Ceti.

It may be well to note that this variable star is exceptionally bright at its present maximum, the magnitude being about 2·0. As usual when the star is bright, it is less red than its average. T. W. Backhouse.

West Hendon House, Sunderland, December 1.

A GEOLOGICAL HISTORY OF DEVONSHIRE[1]

THE title of this book requires some explanation, for the subject-matter is not a description of the existing scenery of Devon, or of the manner in which its various features have been developed out of the rock-surfaces which last rose above the sea It is mainly a description of the physical and geographical conditions under which the rocks of the south-west of England were formed, it is an endeavour (as indicated by the subtitle) to follow the geographical evolution of the region, and to picture the successive stages in the development of its physical geography

The aim of the author has evidently been to present what is known of the geological history of Devonshire in as interesting a form as possible, hence, as stated in the preface, he has used "the minimum of technical language with the object of making them (his pages) suitable for the beginner and the ordinary reader who has no previous knowledge of the subject, but who cares to know how Devonshire came to be what it is"

Moreover, he has contrived to include much general information regarding the rocks of the British Islands, and since many modern geologists consider that professorial teachers of geology have dwelt too much on the lithological and structural branches of the science, and too little on its connections with physical geography, such a book as this ought to find a welcome in many quarters

After an introductory chapter devoted to "Protozoic" time, "we reach the date when the history of Devon begins to be readable from its own records," this, of course, being the Devonian period Having first indicated the probable geography of Britain at this time, the author describes the rocks of North Devon, indicating the great compression and contortion to which they have been subjected He mentions the diverse views which have been held regarding their succession, and wisely remarks that further investigation is required before this matter can be settled

The next chapter is devoted to the Devonian of South Devon, of which a good description is given, with a glance at the schistose area of the Start laying stress on the fact that the results of compression and metamorphism become greater in the direction of these crystalline rocks It was perhaps to be expected that he would repeat the statement that the Devonian limestones are essentially of coralline origin, and are to be regarded as ancient coral-reefs, for he could quote a recent Geological Survey memoir to that effect Nevertheless, its truth has more recently been questioned, and it has been shown that large parts of the limestone are crinoidal, while others are chiefly made up of Stromatoporoids, moreover, we do not know whether any Palæozoic corals were reef-builders

FIG 1—The Haven Cliff, Axmouth Greensand on eroded surface of Keuper Marls From The History of Devonshire Scenery

In chapter vi we find a general account of the Carboniferous rocks before coming to those of Devon, the description of which is not very satisfactory because it is entirely based on the old view that the Coddon Hill cherts overlie the limestones and that the whole group represents the lowest part of the Carboniferous Limestone of Bristol and South Wales, whereas good reasons were given by Dr W Hind in 1904 for placing the cherts below the limestones and for regarding both as the equivalents of the Pendleside

[1] "The History of Devonshire Scenery—An Essay in Geographical Evolution By A W Clayden Pp 202, with 41 photographic illustrations and some diagrams. (Exeter J G Commin, London Chatto and Windus, 1906) Price 10s 6d net

beds which overlie the great mass of the midland Carboniferous Limestone.

For the next two chapters we have nothing but commendation. They deal with the time represented by the great gap between the Culm and the Permian rocks. The first is entitled "The Great Upheaval," and gives a clear and sufficient account of the post-Carboniferous mountain-ranges which are known as the Hercynian or Armorican system, and of the subsidiary Pennine range. This is illustrated by a restoration of the physical geography of the British area at this time. The succeeding chapter is devoted to volcanic rocks, with especial regard to the Carboniferous and post-Carboniferous volcanoes.

In the discussion of the Dartmoor granite in chapter vii. the author is faced by a problem which has given rise to many diverse expressions of opinion. He practically adopts the view advocated by the late R. N. Worth, and sets himself to show "that the granite mass of Dartmoor is really the solidified upper part of the cooled lava reservoir from which the Carboniferous volcanoes of Devon were fed." We think he states the case for this theory with somewhat of over-confidence, for the dissolving of sedimentary rock in the granitic magma is thought by some to be very improbable, and the temperature at which the granite solidified is still a disputed point, while the actual evidence for the existence of volcanoes over the Dartmoor granite is by no means strong. Prominence is, of course, given to the occurrence of peculiar volcanic rocks in the Permian breccias, the origin of which is also dealt with in this chapter.

In the chapter on the "Salt Lake Period" (chapter viii.), an excellent account is given of the Devon Trias and of the conditions under which its successive beds were deposited, the proofs of its salinity and of its barren desert-surroundings being well brought out. The illustrations, too, are especially good, including photographs of "red marl with salt-crystals," "the base of the Budleigh pebble-bed," and "the tea-green marls overlain by the Rhætic bone-bed."

The dawn of Jurassic time and the great climatic change produced by the irruption of the sea into the salt lake are set forth in the opening page of a chapter entitled "The Age of Reptiles." In this the Lias and the Liassic sea are duly described, and the subsequent sequence of Jurassic rocks is briefly indicated, with some remarks on the erosion to which the surrounding land must have been exposed during the whole period, and especially during its closing scenes, when the British area was again upraised, and the sea retreated far to the south and north-east.

Under the title "The Return of the Sea," chapter x. deals with the beginning of the great Cretaceous subsidence. The stratigraphy of the Gault and Greensand is briefly but clearly described, and there are excellent views of the two cliff sections near Seaton Haven cliff and Whitecliff, the former of which we have selected as an example. Then follows a chapter on "The Chalk," in which the peculiar Devon development of an arenaceous Cenomanian overlain by Middle Chalk and a portion of the Upper Chalk is fairly well described. We notice, however, that there is no mention of the "Beer Stone," another Devon speciality, which differs greatly from ordinary chalk and has been largely used as a building stone from Norman times to the present day.

Mr. Clayden appears to be unaware of the views published in the Geological Survey memoir on the Cretaceous rocks of Britain respecting the physical conditions under which the different parts of the Chalk were accumulated. When, therefore, he observes that the facts "are inconsistent with the idea of a deep sea," and assumes that the Chalk (as a whole!) was formed "in a shallow sea perhaps less than 100 fathoms deep," we can only express our surprise.

Chapters xii. and xiii. deal with Eocene time, describing the "Plateau Gravels" and the Bovey deposits, which latter the author considers to be essentially lacustrine, and to have been formed in "the Bovey lake." Chapter xiv., entitled "The Rivers of Devon," is the most original portion of the book, and we only wish that the author had developed this subject at greater length. When we say that he believes the drainage of the whole of northern and central Devon in early Tertiary time to have been carried off by one great river flowing eastward, it will be obvious that such a supposition raises many interesting questions. We are inclined to regard it as a very probable theory, but undoubtedly its details require fuller consideration than he gives them.

The modern scenery of the county, how it is partly an uncovered Permian surface and partly one carved out of an Eocene peneplain, is briefly described in the final chapter. Dartmoor also comes in for further mention, and its type of scenery is well illustrated, as will be seen from the illustration selected.


FIG. 2.—The Crown of the Moor: Yes Tor. From "The History of Devonshire Scenery."

In conclusion it may be said that Mr. Clayden has succeeded very well in the accomplishment of his general intention. The book appeals to a much wider circle than the few readers who may be found in Devon and Cornwall. It really treats of the whole of southern England from Dover to Bude, and should be in the hands of all those who are interested in the geology and the physical geography of our southern counties.

THE UNCIVILISED CHILD.[1]

"THE explanation is rather artistic than scientific"—so the author admits about what he has written on the origin of the "couvade." It is a way of saying that he has found his explanation does not accord with the facts gathered by anthropologists concerning this custom. Such is the keynote of the

[1] "Savage Childhood: a Study of Kafir Children." By Dudley Kidd. Pp. xvi+314. (London: Adam and Charles Black, 1906.) Price 7s. 6d. net.

book; it is artistic rather than scientific It is a life-history of the Kafir child, an excellent record of many facts concerning customs, practices, games, songs, sayings; and it may be particularly commended for the number of capital photographs which illustrate it But the scientific possibilities in all this field of observation have been practically untouched The Kafir baby has not been studied from the Darwinian standpoint, the superstitions which affect him have hardly been looked at with the folklorist's knowledge, racial customs and practices have scarcely been viewed in the light of anthropology

One must have expected to find in savage children many instances of those Simian characters which have been noted among European children, even—because the Kafir child is on a lower scale—to find them more pronounced But the author says nothing about them, and his photographs give very little in this way One picture—it is the frontispiece in the book—shows a shy child, who has instinctively assumed an attitude of self-defence, and has its arm raised as if to ward off a blow, and especially to protect the eyes Now, as fear is the natural basis of shyness, this attitude is very happy It is an inherited instinct, no doubt, but not necessarily Simian, yet if the author had been on the watch for exhibitions of inherited instinct he would certainly have obtained many which were truly Simian in their origin

Had the author been more fully acquainted with folklore results he would not show so many doubts about accounting for various customs For instance, he notices (pp 41, 42) the practice of a Kafir mother protecting her child by leaving a ring of her milk round it, or by squeezing "a few drops of her milk on to its head" He suggests two explanations, but from folklore research he could learn that the second is more nearly correct—that the milk forms a connecting link with the mother, or, rather, that the milk is actually the mother herself present As Mr Hartland says in discussing the life-token, "the external object is believed to be, or to contain, a part of the man himself" ("Legend of Perseus," ii, p 51) The word "part" there is hardly sufficient The external object, the detached portion of a person, or anything which has absorbed a portion of a person, is believed to be more than a part it is rather looked on as the *alter ego*, subject to all his disabilities, endowed with all his potentialities, and just as destruction of the *alter ego* involves destruction of the *ego*, the very basis of witchcraft, so the power to watch and ward, which the *ego* possessed, is supposed to be also inherent in the *alter ego* The mother's milk is as capable a protector as the mother herself

The basis of the same superstition—that a part of self is the other self—is further illustrated by the author in "Confusion of Self with the Clothing and Possessions," "with the Shadow," "with the Picture," "with the Name," and so on (pp 66 *et seqq*), and he gives quite the right explanation of these The man's shadow is but another form of himself, and anything done to his shadow is done to him The "native doctors apply medicine to people's shadows as well as to their bodies" (p 70), that is, application to the shadow is quite as efficacious as to the body So a man refused to be photographed, because the person having the photograph would have a hold on him (p 71)

The secret burning of the child's sleeping mat (p 84) is another case The mat is burnt to prevent it falling into the hands of any evil-disposed person, who could then work ill on the child Here we have the apparent contradiction that meets us in such customs One would at first think that the destruction of the mat would mean the killing of the child So it would, if done with evil intent, because the intention with which an action is done makes all the difference

To conclude, one may quote some admirable remarks of the author on the unfortunate result of ignorant European interference with Kafir customs When it is considered how terrible a failure individualistic civilisation is, at any rate for some millions of our population, and that the remedy is declared to be Socialism, it is quite possible to echo the author's protest against forcing individualism on people who appear to have got great enjoyment out of life under Socialism The author says (p 129),

FIG 1—Boys playing "King of the Castle" on an ant heap near the Zambezi From "Savage Childhood," in which the photo is about an inch longer and wider than this illustration.

"While English magistrates are above suspicion as to the justness of their decisions from a Western point of view, yet the natives complain not a little concerning the injustice of our government In olden days no Kafir felt it to be unjust on the part of a chief to make his subjects work for white men, and yet give their money to him (the chief) To Europeans this is essentially unjust, for it is an infringement of the rights of the individual To the native the rights of the corporate clan are vastly more important than those of the individual Consequently, when in

interest in it" A little more discretion on the part of readers of papers in having regard to the composition of their actual audience would be helpful here In some cases experimental illustration would bring home to a larger number what is followed with difficulty from a merely verbal statement But I am afraid that no complete remedy is within reach.

Increase of specialisation, however inconvenient in some of its aspects, is, I suppose, a necessary condition of progress Sometimes a big discovery, or the opening up of a new point of view, may supersede detail and bring unity where before there was diversity, but this does not suffice to compensate the general tendency Even in mathematics, where an outsider would probably expect a considerable degree of homogeneity, the movement towards diversity is very manifest Those who, like myself, are interested principally in certain departments, and can look back over some forty years, view the present situation with feelings not unmixed It is disagreeable to be left too far behind Much of the activity now displayed has, indeed, taken a channel somewhat remote from the special interests of a physicist, being rather philosophical in its character than scientific in the ordinary sense Much effort is directed towards strengthening the foundations upon which mathematical reasoning rests No one can deny that this is a laudable endeavour, but it tends to lead us into fields which have little more relation to natural science than has general metaphysics One may suspect that when all is done fundamental difficulties will still remain to trouble the souls of our successors Closely connected is the demand for greater rigour of demonstration Here I touch upon a rather delicate question, as to which pure mathematicians and physicists are likely to differ However desirable it may be in itself, the pursuit of rigour appears sometimes to the physicist to lead us away from the high road of progress He is apt to be impatient of criticism whose object seems to be rather to pick holes than to illuminate Is there really any standard of rigour independent of the innate faculties and habitudes of the particular mind? May not an argument be rigorous enough to convince legitimately one thoroughly imbued with certain images clearly formed, and yet appear hazardous or even irrelevant to another exercised in a different order of ideas? Merely as an example, there are theorems known as "existence-theorems" having physical interpretations, the object of which is to prove formally what to many minds can be no clearer afterwards than it was before The pure mathematician will reply that, even if this be so, the introduction of electrical or thermal ideas into an analytical question is illogical, and from his own point of view he is, of course quite right What is rather surprising is that the analytical argument should so often take forms which seem to have little relation to the intuition of the physicist Possibly a better approach to a reconciliation may come in the future In the meantime we must be content to allow the two methods to stand side by side and it will be well if each party can admit that there is something of value to be learned from the point of view of the other

In other branches at any rate, the physicist has drawn immense advantage from the labours of the pure analyst I may refer especially to the general theory of the complex variable and to the special methods which have been invented for applying it to particular problems The rigorous solution by Sommerfeld of a famous problem in diffraction approximately treated by Fresnel, is a case in point We have moved a long way from the time when it was possible for the highest authority in theoretical optics to protest that he saw no validity in Fresnel's interpretation of the imaginary which presents itself in the expression for the amplitude of reflected light when the angle of incidence exceeds the critical value In this connection it is interesting to remember that, in his correspondence with Young, Laplace expressed the opinion that the theoretical treatment of reflection was beyond the powers of analysis The obvious moral is that we are not to despair of the eventual solution of difficulties that may be too much for ourselves

As more impartially situated than some, I may, perhaps, venture to say that in my opinion many who work entirely upon the experimental side of science underrate their obligations to the theorist and the mathematician. Without the critical and coordinating labours of the latter, we should probably be floundering in a bog of imperfectly formulated and often contradictory opinions. Even as it is, some branches can hardly escape reproaches of the kind suggested I shall not be supposed, I hope, to undervalue the labours of the experimenter. The courage and perseverance demanded by much work of this nature is beyond all praise, and success often depends upon what seems like a natural instinct for the truth—one of the rarest of gifts

Copley Medal

The Copley medal is awarded to Prof. Elias Metchnikoff, For Mem R S, on the ground of his distinguished services to zoology and to pathology, particularly for his observations on the development of invertebrates and on phagocytosis and immunity From 1866 to 1882 Prof Metchnikoff's work was exclusively zoological, and mainly during that period he produced a series of brilliant memoirs dealing with the early development and metamorphoses of invertebrates

Although his name stands in the first rank of investigators of these subjects, the most celebrated of his discoveries are those relating to the important part played by wandering mesoderm cells and white blood-corpuscles in the atrophy of larval organs, and in the defence of the organism against infection by bacteria and protozoa It was on these researches that he based his well-known "phagocyte theory" Metchnikoff's fundamental observations were made in Messina in 1882, and were published in the following year In these he showed that the absorption and disappearance of the embryonic organs of echinoderms were effected by wandering mesoderm cells, which devoured and digested the structures which had served their purpose and become effete The observation that white blood-cells accumulate in an inflamed area after infection by bacteria suggested that these cells might also devour and thus destroy the invading microbes, and that the process of inflammation was really a physiological and protective reaction of the organism against infection The study of the infection of Daphnia by *Monospora bicuspidata* entirely justified this prediction The account of the phenomena of infection as seen in this transparent crustacean was published in Virchow's *Archiv* (vol xcvi) in 1884, while, later in the same year, Metchnikoff published another paper extending these observations to vertebrates, and showing the universal applicability of his generalisation as to the essential character of the inflammatory process

During the twenty years which have elapsed since the publication of the "phagocyte theory," Metchnikoff, with the assistance of a host of pupils and disciples from all parts of the world, has been continuously engaged in the study of the reaction of the organism against infection, and in investigating the essential features of immunity in the light of the illuminating generalisation laid down in 1884

Though of limited range, and therefore inferior in scientific importance to the more fundamental researches carried out by him previously, Metchnikoff's recent work on infection by the microorganism of syphilis and the attainment of protection and immunity against this disease may be mentioned on account of its important practical applications

It is not too much to say that the work of Metchnikoff has furnished the most fertile conception in modern pathology, and has determined the whole direction of this science during the last two decades

Rumford Medal

The Rumford medal is awarded to Prof Hugh Longbourne Callendar, F R S, for his experimental work on heat

Prof Callendar has devoted his attention chiefly to the improvement of accurate measurement in the science of heat by the application of electrical methods His first paper, "On the Practical Measurement of Temperature," Phil Trans, 1887, paved the way for the application of the electrical resistance thermometer to scientific investigation In a later paper, written in conjunction with

Griffiths, "On the Boiling Point of Sulphur, &c," Phil Trans., 1891, the application of his method was further extended, and a simple method of standardisation was proposed. In continuation of this work Prof. Callendar has written a number of subsidiary papers dealing with details of construction of instruments, and applications to special purposes The results of this thermometric work have since been confirmed by Chappuis and Harker, Phil Trans, 1889, at the Bureau International, Paris, and by other observers, and are now generally accepted

More recent developments in accurate electrical thermometry have been described by Prof Callendar in later papers. He has also devised a special type of "gas-resistance" thermometer, depending on the increase of viscosity of a gas with temperature, which is the exact analogue of the electrical resistance thermometer, and possesses peculiar advantages for high temperature measurements.

The application of electrical resistance thermometers and thermo-couples to the observation of rapid variations of temperature has been utilised by Prof Callendar in the study of the adiabatic expansion of gases and vapours, and in the observations of the cyclical changes of temperature of the steam and of the cylinder walls in a steam-engine. The latter research was undertaken in conjunction with Prof Nicholson, with a view to elucidate the theory of cylinder-condensation

The researches of Rowland and other experimentalists on the specific heat of water and the mechanical equivalent of heat had shown that grave uncertainties affected the value of this most fundamental physical constant, which could not be removed satisfactorily without a complete investigation of the variation of the specific heat of water between 0° C and 100° C Prof Callendar devised a continuous electrical method of attacking this problem, possessing many important advantages as compared with older methods He was assisted by Dr Barnes in carrying out this work, the results of which form the subject of papers by Callendar and Barnes in the Phil Trans Roy Soc, 1901 As an illustration of the probable accuracy of their results it may be observed that, whereas by any of the older formulæ accepted for the variation of the specific heat of water, the values of Rowland and of Reynolds and Moorby for the mechanical equivalent are seriously discordant, they are brought into perfect agreement by the work of Callendar and Barnes

In the subject of conduction of heat Prof Callendar has contributed many original methods described in various minor papers, and, in addition to the thermal investigations with which his name is chiefly associated, has carried out some purely electrical researches

Royal Medals

One of the Royal medals has been awarded, with the approval of His Majesty, to Prof Alfred George Greenhill a fellow of the society on account of the number and importance of his mathematical investigations produced between the year 1876 and the present time They embrace a variety of mechanical and physical subjects, including dynamics, hydromechanics electricity, and gunnery He is the author of two treatises on hydromechanics, both remarkable for originality of treatment

The subject, however to which he has devoted most time and attention is the theory of elliptic functions His work on this subject may be placed in two classes —(1) Investigations in which he has extended the subject into new fields, as in the series of memoirs on the "Transformation and Complex Multiplication of Elliptic Functions," contributed to the Proceedings of the London Mathematical Society (vols xix xxi xxv, xxvii), and in the memoir on the "Third Elliptic Integral and the Ellipsotomic Problem," in the Phil Trans (vol cciii) (2) Applications to mechanical problems mainly dynamical, for purposes of calculation or illustration In this class may be placed his treatise on the elliptic functions as well as numerous papers in journals and the proceedings of scientific societies

All Prof Greenhill's work is characterised by much originality, and by a rare power and skill in algebraic analysis

His Majesty has also approved the award of a Royal medal to Dr Dukinfield Henry Scott, also a fellow of the society, for his investigations and discoveries in connection with the structure and relationship of fossil plants Dr Scott began the very important work which he has accomplished in this subject by helping the late distinguished palæobotanist, Prof W C Williamson In this cooperation he greatly enhanced the value of Williamson's work He not only added many new discoveries, but, what was more important, demonstrated the value of the work in relation to phylogeny

Dr Scott has since added much of first-rate importance He has discovered and elucidated many important types, his work constituting a most valuable acquisition to botany from the evolutionary point of view It is not only in the accurate investigation of difficult structures that Dr Scott has been so successful, not the least of his merits lies in the philosophical treatment of the problems suggested by his discoveries His position as one of the leading palæobotanists in the world is well recognised He has, both by his personality and by his writings, exercised a well-marked and widespread influence on the work of other botanists The fact that he has created in this country a vigorous school of palæobotanists may be regarded as an additional claim for the honour now conferred upon him

Davy Medal

The Davy medal is given to Prof Rudolf Fittig, professor of chemistry in the University of Strassburg, who began to publish scientific work as early as 1858, and in 1864 discovered the method for the synthesis of hydrocarbons homologous with benzene, which has ever since borne his name Up to about 1880 he worked chiefly on benzene derivatives, but his attention was gradually attracted to the study of lactones and acids, both saturated and unsaturated, which has largely formed the subject of his numerous published papers down to the present day

Fittig has been a remarkably active worker The Royal Society Catalogue contains under his name alone ninety-six papers, and, jointly with students and others, seventy-one more down to 1883 Since that time a number about equally large has been recorded in the indexes of the chemical journals The work of Fittig and his students on lactones and acids and particularly the intermolecular changes which many unsaturated acids undergo, may be said to be classical, and it has had an important influence on the progress of theoretical chemistry

Darwin Medal

The Darwin medal has been awarded to Prof Hugo de Vries, For Mem R S Prof de Vries has made a series of important discoveries in connection with the manner in which new races of organisms may originate, and he has materially extended and systematised our knowledge of the laws affecting the results of hybridisation His work is the outcome of very extensive experiments that have been carried on for many years He has stimulated numerous investigators, both in Europe and in America, to extend these inquiries, and the results already obtained are of great importance, both from a theoretical and from a practical point of view De Vries's work has exercised considerable influence on other branches of biology, and has suggested new lines of investigation in many directions

Hughes Medal

Mrs W E Ayrton is the recipient of the Hughes medal, which is awarded for original discovery in physical sciences, particularly electricity and magnetism, or their applications Her work on the electric arc has been described in a paper published in the Philosophical Transactions, and in various other publications

Mrs Ayrton's investigations cover a wide area She discovered the laws connecting the potential difference between the carbons of an arc with the current and with the distance between them, and proved these to apply, not only to her own experimental results, but to all the published results of previous observers Dealing with the modifications introduced into the arc by the use of cores in the carbons, she found the causes of these modifications The peculiar distribution of potential through the arc was traced, and its laws were discovered by her

Having found the conditions necessary for maintaining a steady arc, and for using the power supplied to it most efficiently, she was able to explain the cause of "hissing," and the causes of certain anomalies in the lighting power of the arc.

For the past four years Mrs. Ayrton has been engaged in investigating the causes of the formation of sand ripples on the seashore.

At the annual dinner, the Norwegian Minister, Dr. F. Nansen, proposed the toast of the Royal Society, and Sir William Huggins responded to it. Speeches were also made by Prof. Hugo de Vries, Prof. Callendar, Lord Kelvin, and the Italian Ambassador. In the course of his remarks Dr. Nansen said:—

Ibsen, my great compatriot, has in one of his works formulated the paradox that the man is strongest who stands most alone. There is certainly some truth in this—nay, there is much truth in it so far as science is concerned. The man who, in the search for truth, goes his own way independently of other men and of other considerations, is certainly the man who is apt to find the greatest and most valuable truth. On the other hand, it is also true that science, more than most other things in life, depends on cooperation, on the help of one's fellow-beings, and this becomes more and more true every day. Many people are apt to forget what science actually is, and what they owe to science, for it is through science that modern society actually exists, and the development of society as it is to-day would be impossible if science were eliminated. Humanity is growing, but if science and the means created by science are not growing humanity certainly will have to look forward to a very miserable future. Therefore the nation that wishes to be cared for must support science and those who carry on scientific work. Science will live her own life, and has done so ever since the days when Prometheus made his fatal expedition to the gods and stole the fire which is more or less burning in every one of us, and cannot be extinguished. There is something sublime in this everlasting fire of science. Generation after generation disappear, the individual is nothing, but always "Watchful in the tower man shall remain in sleepless contemplation."

NOTES

WE regret to have to record the death of Sir Edward J. Reed, K.C.B., F.R.S., on November 30, at seventy-six years of age.

IT is announced that this year's Nobel prize for chemistry has been awarded to Prof. H. Moissan, and the prize for physics to Prof. J. J. Thomson, F.R.S. The prize for medicine has been awarded to Prof. C. Golgi, of Pavia, and Prof. Ramón y Cajal, of Madrid.

THE Physical Society will hold an exhibition of electrical, optical, and other physical apparatus at the Royal College of Science, South Kensington, on Friday evening, December 14. Admission will be by ticket only.

IT is announced that Prof. Gariel has resigned the secretaryship of the council of the French Association for the Advancement of Sciences after having performed the duties for about thirty years.

IT is reported from Bombay that experiments in wireless telegraphy carried out between Landi Kotal and Peshawar have demonstrated the fact that the interposition of higher mountains does not interfere with free communication between two places in a mountainous country.

A JOINT committee has been formed of the county councils of the East and West Ridings of Yorkshire and the county boroughs of Bradford, Hull, Leeds, Rotherham, and Sheffield, to carry out an investigation as to the conditions of the milk supply of the district. The investigation is to be continued for twelve months, and the committee will shortly appoint a bacteriologist to make the necessary examination of samples of milk taken at various stages of transit to the consumer.

THE annual meeting of the German Society of Naval Architects was held in Berlin on November 22 in the presence of the German Emperor. A paper was read by Mr. Boveri on the Parsons marine turbine, in which he gave an account of steam-turbine trials in the German Navy. In the discussion that ensued it was urged that steam turbines possess various disadvantages. They render a ship less easy to steer and control; they are more complicated than ordinary engines, and, above all, they are 60 per cent. to 80 per cent. more costly. Notwithstanding these considerations, the large cruiser which is to be laid down next year will be fitted with steam turbines.

No work in medicine is of much use unless it is in living union with the study of the natural history of disease. This was the position taken by Sir Thomas Barlow in the course of some remarks made in opening, on November 28, a new Manchester and Salford Hospital for Skin Diseases. It is only when this purpose is kept in view that any solid advance can be made; it is only by trying to find out the causes and conditions under which diseases come, and by investigating their natural evolution, that real advance can be secured. In devoting a room to study and research, and in fitting it up with modern appliances, the committee of the new hospital has done something to stamp out quackery. In connection with skin disease, English people are very benevolent, but they have not yet learnt, as the people across the Atlantic have learnt, to give money for research; they give plenty of money for asylums and for hospitals, but for research which carries on the study of disease and advances knowledge on sound and progressive lines, that is one of the things which they, practical people as they are, have not yet realised.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Mr. W. Duddell, a Christmas course of six experimentally illustrated lectures on "Signalling to a Distance, from Primitive Man to Radiotelegraphy," adapted to a juvenile auditory; Prof. Percy Gardner, two lectures on the sculpture of Aegina in relation to recent discovery; Prof. A. C. Seward, two lectures on survivals from the past in the plant world; Prof. W. Stirling, six lectures on the visual apparatus of man and animals; Dr. W. N. Shaw, two lectures on recent advances in the exploration of the atmosphere; Major P. A. MacMahon, two lectures on the standards of weights and measures; Prof. W. W. Watts, two lectures on (1) the building of Britain, (2) recent light on ancient physiographies; Dr. C. W. Saleeby, two lectures on biology and progress; and Prof. J. J. Thomson, six lectures on Röntgen, kathode, and positive rays. The Friday evening meetings will commence on January 18, when Sir Andrew Noble will deliver a discourse on fifty years of explosives. Succeeding discourses will probably be given by Sir Almroth E. Wright, Mr. J. J. Lister, Mr. Dugald Clerk, Prof. D. J. Hamilton, Prof. J. J. Thomson, and Prof. G. Lunge.

AT a recent meeting of the Royal Photographic Society Mr. Thomas Manly described and illustrated his modification of carbon printing, "ozobrome," which is rapidly gaining appreciation. The chief advantage of the new method is that carbon prints can be made without any exposure to light if a "bromide" print of the subject is available. The reduction of the bichromate in the carbon

tissue is effected by the silver image of the print It is only necessary to soak the hardened bromide print in water and the prepared carbon tissue or "plaster" in a solution that contains a bichromate, a ferricyanide, and a bromide, to squeegee the two together, and leave them for a short time under slight pressure The pigment plaster is then separated and treated exactly as if it had been exposed to light under a negative The silver of the bromide print has been converted by the process into a salt, but by treating it with a developing solution it is reduced to the metal again, and by this round of operations it will furnish "ozobrome" prints until it becomes destroyed by the handling. Mr Manly indicated a collateral advantage of the method in that it is independent of the colour of the pigment in the "plaster," while by the usual method of exposure to light the effect of the exposure penetrates more deeply in the presence of a blue than of a red or brown pigment

By the death of Emil Schmidt in his seventieth year a typical German anthropologist passes away Like many of his fellows he studied medicine, and was actually in practice for some twenty years He first directed his attention to American archæology, and dealt in particular with the Copper age His anatomical knowledge led him to take up physical anthropology, and he possessed a considerable collection of skulls, now in the Anatomical Institute at Leipzig, where he was for a time a recognised lecturer, and later extraordinary professor He was among the first to study the human remains at Pompeii, and a stay in Egypt enabled him to make a further study of early historic material Some years later he visited India and Ceylon, the whole of the material which he then collected was not published, but his "Reise in Sued-Indien" and "Ceylon" contain much valuable information In the much discussed problem of the Neanderthal skull he accepted in opposition to Virchow, the view that it is really that of a lower human species or genus, in the question of prehistoric pigmy races, on the other hand, he held that more evidence was needed as a basis for Kollmann's speculations In consequence of failing health he resigned his professorship in 1900, and occasional contributions from his pen appeared in *Globus* and other papers, but he knew that his life's work was done, and was seldom seen in scientific circles

We have received from the author, Mr J A Kershaw, of the Melbourne Museum a copy of a paper on additions to the fish-fauna of Victoria, published in the *Victorian Naturalist* for October Not any of the species are new

The record of fourteen years continuous breeding of the marsh-warbler in an Oxfordshire parish forms the opening article of the November *Zoologist*, the present year being the first since 1892 in which Mr W W Fowler has been unable to discover a nest of the species Ornithological notes made in Oxfordshire in 1904 form the subject of an article by Mr O V Aplin, while Mr E Selous discourses on sexual selection in the ruff

The slow-lorisis (Nycticebus) of the Indo-Malay countries, all of which have hitherto been generally regarded as members of a single variable species, are divisible, according to Mr M W Lyon (Proc U S Nat Mus, No. 1494), into two distinct groups, in one of which a distinct sagittal crest is developed on the skull of the adult, while in the other no such ridge occurs The second group occurs only in Borneo and Banka, and appears to be further characterised by having only one (in place of two) pair of upper incisor teeth

Copies are to hand of the second part for 1905, and of the first part for 1906, of the *Verhandlungen des naturhistorischen Vereins* of Prussian Rhineland, Westphalia, &c, published at Bonn The contents of the former include articles on a peculiar rock, essexit (heptorite), from Siebengebirge, on a portion of the Mayence Tertiary basin, on the ostracods of the Brunswick district, on the extinction of *Planaria alpina* in certain districts, and on some rare or exterminated plants of Rhineland The issue for 1906 is occupied by the first portion of a synopsis of the birds of the Rhine Province, by Dr Otto le Roi, of Bonn

We have received Heft ii and iii of the "Meeresfauna von Bergen" edited by Dr A Appellöf (Bergens Museum, 1906, pp 75–233, four plates, and three maps) In the first memoir Mr O Nordgaard reports on the Bryozoa of the west coast of Norway, in the second memoir Dr Appellof discusses the decapod crustaceans of the same region, with particular reference to their vertical and horizontal distribution It is shown that conditions of temperature and salinity are of fundamental importance in determining the distribution, though other factors, such as pressure nature of the bottom illumination, and chemical composition of the water are also operative

The origin of species, more especially in connection with variation and Mendelism, forms the leading feature of the issue of *Verhandlungen der Schweiz Naturfor Gesellschaft* for the present year The articles on this subject relate to the evolution of species generally, Mendelism as exemplified by hybridising garden and other snails, variation in butterflies, mutation in the harts-tongue fern, and species formation among bacteria and parasitic funguses In the case of the garden snail (*Helix hortensis*) Dr Arnold Lang shows that by crossing members of uniformly yellow shelled colonies with the fully-banded strain it will be found that the progeny follows to a great extent the Mendelian law in regard to the numerical proportions of the various colour-phases The issue concludes with a number of biographies of scientific men, accompanied by portraits

The most generally interesting article in the October number of the *Emu* is one by C I Barrett of Melbourne, on the origin of parasitic habits in cuckoos It is stated that one American species (*Coccyzus americanus*), which is generally in the habit of building a nest and hatching its own eggs, occasionally lays in the nests of other birds Another instance of the commencement of the parasitic habit is afforded by the Indian hawk-cuckoos of the genus Hierococcyx, five species of which lay in the nests of babbling thrushes while the sixth is reported to make a nest of its own In reference to the frequent resemblance between the eggs of cuckoos and those of the birds on which they are parasitic, the author cites a theory that the food of nestlings has much to do with determining the colour of the eggs which they may subsequently lay "If such be the case" he observes, "it goes far to explain the similarity between the eggs of many species of cuckoos and those of their foster-parents" The argument is, however, scarcely carried far enough for it is obvious that, if true, the explanation will likewise apply to "hedgesparrow-cuckoos" and "wagtail cuckoos" in the case of the European species

A FEW days' stay at the island of Ascension when the Scottish National Antarctic Expedition was returning home provided an opportunity for exploration Mr R. N R Brown furnishes an account of his botanical observations and collections to the second part of vol xxiii of the Transactions and Proceedings of the Botanical Society of Edinburgh Of the four phanerogams regarded as indigenous, only *Portulaca oleracea* and *Euphorbia origanoides* were found, but of the cryptogams collected four provided new records for the island

A NEW Russian botanical journal, representing the botanical section of the Imperial Society of Naturalists of St Petersburg, has been inaugurated under the editorship of Mr B Fedtschenko The first number contains a description, by Mr W Sukatscheff, of a new variety of *Pinus Pityusa* from the Crimea, and an ecological account of the flora of the province of the Don Cossacks is contributed by Mr W Droboff A feature of some interest in the latter is the occurrence of *Utricularia minor, Sparganium minimum, Eriophorum latifolium*, and other northern types

SEVERAL contributions concerned with the determination of Philippine plants are published as a fourth supplement to the first volume of the *Philippine Journal of Science* The list of new asclepiads determined by Dr R Schlechter includes species of Tylophora, Dischidia, and Hoya, and the same writer describes an endemic Burmannia allied to *Burmannia nepalensis* The Acanthaceæ were identified by Mr C B Clarke, and the Myrsinaceæ by Prof C Mez Among the second series of grasses named by Prof E Hackel are a curious Chionachne and a species of Ischæmum A second list of ferns contributed by Dr E B Copeland contains, among others, new species of Schizoloma, Athyrium, and Polypodium, and a collated list of Philippine fungi, prepared by Mr P L Ricker, is also published

IN the Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol l, part i) there is an able article on the development and present status of the steam turbine in land and marine work by Mr E M Speakman The author gives some valuable general considerations affecting their adoption, and incidentally points out that while the solution of the gas-turbine problem does not seem entirely impossible, little or no direct development can be expected until numerous difficulties of a practical nature have been overcome

A THIRD report on the geological features and mineral resources of the Pilbara goldfield, by Mr A Gibb Maitland, has been issued as Bulletin No 23 of the Geological Survey of Western Australia It covers ninety-two pages, and is accompanied by seven geological maps and thirteen illustrations It completes the descriptions of those mining centres in the goldfield to which no reference was made in the previous two Bulletins, and includes full details of the gold-mining districts of Tambourah, Western Shaw, Northern Shaw, and Just-in-Time, as well as of the tin-fields of Wodgina and Cooglegong It contains, in addition, an able summary of the mineral resources and future prospects of the whole goldfield If prospecting operations are carried on with due regard to the geological conditions, there can be no doubt that the district will continue to be a gold, tin, and tantalite producer The various tantalates and niobates of the rare earths, which exhibit marked radio-active properties, have been found to occur as primary constituents of the pegmatites such as are found at Wodgina It is probable, therefore, that careful search may result in the discovery of various radio-active minerals As minerals of subordinate importance, diamonds, scheelite, asbestos, and argentiferous lead ores are met with. Iron ores occur plentifully throughout the district, but at present such ores, though of high grade, are entirely beyond the reach of commercial enterprise.

VOL xxxvii of the *Sitzungsberichte* of the Physico-medical Society of Erlangen for the year 1905 shows a very marked increase in the activity of the society as compared with previous years The following papers may be noticed as possessing special interest —a detailed investigation of electric discharges, by Mr R Reiger (pp 1–130), a series of papers by Prof E Wiedemann dealing with the history of science, and referring in particular to the early scientific knowledge of the Arabs, details of the determination of the atomic weight of tellurium by Mr A Gutbier, and of bismuth by Mr H Mehler, and a paper on radio-tellurium by Mr F Henrich

SINCE the first X-ray tube was constructed by Prof Rontgen, many modifications have been introduced of greatly increased efficiency The most recent improvements have been directed to the purpose of making the vacuum adjustable, so as to be able to convert, for instance, a tube which has become very "hard" into a tube of a "softer" character Mr Rosenthal, of Munich, describes in the *Verhandlungen* of the Berlin Röntgen Congress, 1906, a new type of tube, in which, it is contended, the character of the vacuum does not undergo variation at all after prolonged working The principle consists in absorbing all those rays which emanate from the anti-kathode and are not true Röntgen rays, by an internal aluminium 'filter", these rays do not, therefore, strike the glass walls of the tube or produce the customary heating and chemical effects which cause the vacuum to change It is claimed that the new device is a really substantial improvement, both as regards convenience and economy

AN interesting study of the question whether an enzyme is capable of possessing more than one kind of activity is contained in a paper by Messrs L Marino and G. Fiorentino published in the *Gazzetta* (vol xxxvi, ii, p 395) It is contended that the maltase of malt, free from emulsin and invertase, is capable, not only of decomposing maltose but also of hydrolysing the natural and artificial glucosides which are susceptible to the action of emulsin The absence of the latter in the maltase is held to be proved by the fact that the enzyme recovered after the action of maltase on amygdalin has taken place is almost without effect on salicin, whereas if a trace of emulsin is added to the maltase the enzyme recovered under similar conditions almost completely hydrolyses salicin The activity of maltase appears, indeed, to be destroyed by the products of the hydrolysis of amygdalin, whilst the latter do not affect emulsin The maltase of malt seems to be very similar to the maltase of beer yeast, as it is capable, like the latter, of producing the same isomaltose synthetically from glucose, but it differs from it in hydrolysing the β, not the α-glucosides.

THE formation of hydrocyanic acid in plants, which was first investigated in the case of bitter almonds by Liebig and Wöhler in 1837, has recently attracted attention owing to the discovery by Prof Dunstan and Dr Henry in certain fodder plants, known to cause cattle poisoning, of definite

glucosides susceptible of decomposition by specific enzymes with the production of the highly-poisonous prussic acid In a communication to the Royal Academy of Belgium (Bulletin No. 8, p 613) M P Fitschy adds another half-dozen common plants to the number of those already known to produce prussic acid in the early stages of their growth Among the Ranunculaceæ are *R repens* and *R arvensis*, and among the grasses *Gynerium argenteum*, *Melica altissima*, *M nutans*, *M uniflora*, and *M ciliata* It remains to be ascertained whether the prussic acid is originally elaborated in each plant in the form of a definite glucoside, and whether a specific enzyme is responsible for its decomposition

A NEW edition of Mr Sidney Lupton's "Numerical Tables and Constants in Elementary Science" has been published by Messrs Macmillan and Co, Ltd. The present issue is substantially similar to the last edition, but a few values have been corrected, and an addendum of two pages contains important values and constants recently obtained

A SUPPLEMENT to the report of the Rugby School Natural History Society for the year 1905 has been published It contains a paper by Mr G L Keynes on a late Roman settlement near Somersham, Hunts, and is illustrated with photographs and drawings of the objects found during the excavation of the settlement

MESSRS BRADY AND MARTIN, LTD, of Newcastle-upon-Tyne, have issued the seventh edition of their well-arranged catalogue (pp 700) of scientific apparatus This enterprising firm is prepared to supply instruments and material for the practical study of all branches of science, and teachers will do well to examine the volume when selecting apparatus or accessories for lecture-room or laboratory

THE use of models for the teaching of solid geometry forms the subject of two articles by M Charles Playoust in *Cosmos* for September 8 and 15, the object being to show how easily models can be constructed out of cardboard or with strings by a teacher or student, in cases where the cost of a set of proper models would be prohibitive

AN English version of Prof H Poincaré's articles on "The Value of Science" is appearing month by month in the *Popular Science Monthly* The November article deals with "The Notion of Space" A German translation of the same book by Prof and Frau Weber, of Strassburg, has been published by Teubner, of Leipzig

OUR ASTRONOMICAL COLUMN

DISCOVERY OF A NOVA —Circular No 121 of the Harvard College Observatory contains an account of the discovery, by Miss Leavitt, of a new star in the constellation Vela This object was discovered on a plate taken with the 1-inch Cooke lens on December 5, 1905, and also on fourteen plates taken between that date and June 29, 1906 Its position, for 1900, is

$$\text{R A} = 10\text{h } 58\text{m } 20\text{s}, \text{ dec} = -53^\circ\ 50'\ 9$$

On a plate taken on July 12, 1905, showing stars down to magnitude 11 5, Nova Velorum is not to be found, nor did it appear on the 127 plates of this region taken between 1889 and December, 1905, all of which have been examined and found to show stars down to the eleventh magnitude

So far as can be determined from the Harvard plates, the greatest magnitude attained by this Nova was 9 72, the magnitude on December 5, 1905, and January 26, 1906 There were considerable fluctuations of light during the period covered by the observations, and Prof Pickering thinks there is little doubt that the object observed is actually a Nova

COMETS 1906*g* AND 1906*h* —Observations of these two comets are recorded in Nos 4135–6 of the *Astronomische Nachrichten* Observing at Arcetri, Prof Abetti saw comet 1906*g* as a round, uniform nebulosity of 2′ diameter, in which neither nucleus nor any trace of a tail could be discerned Prof Ambronn, at Gottingen, found a feeble condensation, but no nucleus, on November 19 According to Prof Nijland, the magnitude, as estimated from an opera-glass observation on November 19, was 7 7

A set of elements computed by Herr M Ebell for comet 1906*h*, and published in Circular No 94 from the Kiel Centralstelle, shows that this body passed through perihelion on September 15 The Circular also gives an ephemeris from November 26 to December 16, which shows that the comet's brightness is decreasing

OBSERVATIONS OF NOVA SAGITTARII —Since May 10, 1899, Prof Barnard has observed Nova Sagittarii on many occasions with the 40-inch refractor at Yerkes, and now publishes the results in No 4136 of the *Astronomische Nachrichten* This Nova was discovered from the Harvard photographs, of which one, taken on March 8, 1898, showed it to be of magnitude 4 7 Prof Barnard's observations gave the following magnitudes for the mean dates of the years named —1899, mag 11 0, 1903, mag 13 8, 1906 mag 14 8 From these it appears that the Nova may fade entirely from view in the next few years The published positions of this star seem rather discordant, so Prof Barnard has investigated the matter, and gives data which will prevent the position of the Nova from being mistaken The appearance of the Nova in the 40-inch telescope is that of a very small nebula, or hazy star, about 1″ in diameter Extending the focus about one-quarter of an inch seemed to improve the definition, but still left the image of the Nova hazy, something like the abnormal stars in the cluster M13 Herculis

TWO STARS WITH VARIABLE RADIAL VELOCITIES —From spectrograms taken at the Potsdam Observatory, Prof Hartmann has discovered that the two stars RZ Cassiopeiæ (an Algol variable provisionally designated 77 1906 Cassiopeiæ) and γ Cassiopeiæ have variable radial velocities In the former case the spectrograms show a variation between +33 1 km (October 1, 1906) and −11 9 km (October 4, 1906), the first value obtaining about one-quarter of the star's period before, and the second about the same length of time after the minimum The measures of the spectrograms of γ Cassiopeiæ gave values between +3 1 km (September 21, 1900) and −19 3 km (September 27, 1901) Owing to the hazy character of the lines in the spectrum of this star, the resulting velocities are somewhat uncertain (*Astronomische Nachrichten* No 4135)

GRAPHITIC IRON IN A METEORITE —In an extract (No 1497) from the Proceedings of the U S National Museum Mr W Tassin describes the physical and chemical properties of a nodule of graphitic iron found in the Canyon Diablo meteorite The mass was found on examination to be a septarian nodule, the septa consisting of native metals similar to the mass of iron The interseptal portions consist of crystalline graphitic and amorphous carbon, mixed with a very fine granular or scaly troilite There is also present a lustrous metallic substance differing from cohenite in that it is soft enough to leave a mark on white paper, is dark steel-grey in colour, and occurs in angular, foliated masses Chemical analysis showed that this material contained iron (88·8 per cent), nickel (4 0 per cent), silicon (2·0 per cent), carbon (4 3 per cent) phosphorus (0 9 per cent), and a trace of cobalt

NEW VARIABLE STARS —In No 4126 of the *Astronomische Nachrichten* Prof Max Wolf announces the discovery of thirty-one new variable stars in the region about β Cygni The variability of these objects was discovered from plates taken with the Bruce telescope with exposures ranging from 150 to 220 minutes A number of separate charts show the positions of these stars

RECENT PROGRESS IN MAGNETO-OPTICS [1]

It is my intention this evening to give you a general review of the experimental researches which have occupied me during the last few years They all refer to the relation between magnetism and light, a relation the first and fundamental example of which was discovered in this very institution by Faraday in 1845

Surely every physicist should feel inspired by the idea of having the privilege to address an audience in the same lecture room, where so often some of nature's deeper mysteries were revealed, and I feel the uplifting force of this inspiration all the stronger, as my own work for many years has been so closely connected with one of Faraday's discoveries Faraday discovered that the plane in which the vibrations of light take place *rotates* whenever a ray of light is propagated parallel to the magnetic lines of force through some substances, such as Faraday's own heavy glass, this fact we now indicate by the term *the magnetic rotation of the plane of polarisation* The discovery of this fact opened the chapter of magneto-optics

Faraday's mind again and again returned to the relation between magnetism and light, and incessantly he sought for closer and more intimate connections, in one experiment in March, 1862 (which is said to have been his last), he tried to observe a change in the spectrum of a flame when acted on by a magnet The entry in Faraday's note-book, preserved in this institution with pious care, concludes with the words, "not the slightest effect on the polarised or unpolarised ray was observed" As we now know, the means of Faraday's time were not powerful enough to observe the effect sought for Various physicists since Faraday have sought in the same direction, some have recorded their negative results, others have not, for most physicists have an almost invincible dislike for the publication of negative results, though a collection of such unsuccessful attempts, if precisely stated, would be most interesting, and should afterwards prove very valuable

Magnetisation of the Spectral Lines

In my own case, the thought to submit a source of light to the influence of magnetism occurred to me during a quantitative investigation of the effect discovered by Kerr concerning the light reflected by magnetised mirrors I was working at the time in Leyden, in Prof Onnes's laboratory The account of Faraday's negative experiment encouraged me in my endeavours, and also an argument in 1856 by Lord Kelvin referred to by Maxwell as the "exceedingly important remark of Sir W Thomson" If it might be accepted that the forces operating during the propagation of light in magnetised substances exist also whenever the source of light is in the magnetic field, we can expect some direct effect of magnetism on radiation

My own successful experiments date from 1896 to 1897, whereas three years earlier I also had recorded a negative result not having then used adequate means

As you know, a sodium flame chiefly emits two kinds of yellow light and accordingly its spectrum, when analysed with one of Rowland's large concave gratings shows two yellow lines With a grating of medium size these lines have a distance of one millimetre they are rather narrow as shown in the slide In August, 1896, I found that when a sodium flame is placed between the poles of an electromagnet, and is looked at with a spectroscope in a direction at right angles to the lines of force, the yellow lines in its spectrum become somewhat wider when the magnetic field is put on [2] This fact can be expressed in a different way by saying that, besides the original vibrations, a flame in a magnetic field emits other vibrations, of which some have a somewhat greater, and some a somewhat smaller frequency than the original vibrations

This observation of a small change in a spectral line was the origin of my subsequent work I realised that this change however small, was worth a closer examination Indeed, it seemed clear at once that here we had a means of studying the internal vibrations of a molecule by modifying in a simple way the conditions under which they are going on Of course, the result was verified in all directions As there is now, I think, no doubt as to the reality of the observed changes, I shall only refer very briefly to this stage of the work. In the first place, the widening of the lines was observed in the direction of the lines of force also. Then the fact was established that to the observed *direct* effect there corresponds an *inverse* one. When white light traverses the incandescent sodium vapour we observe the absorption lines, these also are widened when the vapour is subjected to magnetic forces. Secondary influences were discarded by suitable modifications of the experiments In one case no change was observed The spectra of fluted bands, such as those of iodine, carbon, or nitrogen, did not show any effect, nor could Becquerel and Deslandres using increased power discover it

Before I could answer the different questions which presented themselves, I had the advantage that the beautiful theory of the electromagnetic and optical phenomena, developed by my friend Prof Lorentz, gave its quickening influence to my experimental work.

In this theory it is supposed that the material world is built up of three things, ponderable matter, ether, and *electrons* I think it is rather superfluous to remind you here in the land of Maxwell, Kelvin, Crookes, J J. Thomson, Schuster, Larmor, Heaviside, and Johnstone Stoney, that electrons or corpuscles are exceedingly small, electrically charged particles, which are supposed to be present in all material bodies

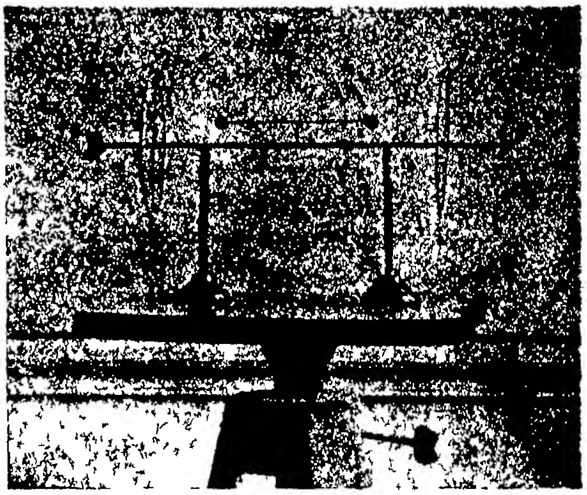


FIG 1

These electrons can perform oscillations under the influence of the forces which attract them to their position of equilibrium Because they are electrified they have sufficient hold on the ether to excite in it the electromagnetic vibrations which, according to Maxwell's theory, constitute light The oscillatory periods of the electrons determine the position of the lines in the spectrum, and with every change in the period of oscillation we observe a displacement of the corresponding line

In Lorentz's theory the explanation of the effect of a magnetic field is as simple as it is beautiful

The forces operating on the vibrating electron in a magnetic field are fairly well known These forces are the same which curve the path of the kathode rays in a vacuum tube which is acted on by a magnet All motions of the electrons in the molecules of a flame may be supposed to be made up of three particular motions, chosen in such a manner that the action of the magnetic field on each of them can be easily foreseen The light of the flame is exactly the same as it would be if the flame contained three groups of electrons vibrating in these simple ways In this model the electrons are represented by red balls, the black arrow indicates the direction of the magnetic force (Fig 1)

[1] Discourse delivered at the Royal Institution on Friday, March 30, by Prof P Zeeman

[2] Zeeman, Verslagen Kon Akademie v Wetenschappen, Amsterdam, October and November, 1896 *Phil Mag*, March, 1897

As a first simple motion we choose a vibration parallel to the lines of force. On the group of electrons which possess this motion the magnetic force has no influence, the period, which we call T, remains unmodified The other two simple motions are circular motions, clockwise or anti-clockwise, in planes perpendicular to the lines of force

An electron performing either of these rotations will be acted on by a force which is directed towards or from the centre, dependent on the direction of the rotation The magnetic field must, therefore, cause the speed of the electron either to increase or to decrease, and so will either diminish or increase the period Therefore, instead of one motion with period T, we get under the influence of the field three motions with periods T, $T+v$, $T-v$, v being a small quantity To each motion of the electrons there corresponds a luminous vibration, according to the electromagnetic theory of light Observing with a spectroscope we must, therefore, see each spectral line divided into three lines, each line becomes a *triplet*[1]

I will show you a few examples of lines which are really divided into three components in accordance with Lorentz's theory (Fig 2, iron, Fig 3 part of iron spectrum)[2] You will notice that each of the components remains very narrow, it is not a hazy effect, but a very definite one This certainly would not be the case if all molecules did not behave in the same manner, and if certain conditions of isotropy of the molecules were not fulfilled[3]

FIG 2

The consideration of the model may illustrate some other points which were foreseen by Lorentz's theory Consider the light emitted at a right angle to the lines of force The three kinds of light seen in this direction are each due to vibrations of one kind, and therefore polarised We can, therefore, extinguish the light of the central component or of the two external components of the triplet by a Nicol In one half of the slide shown the external components are extinguished, in the other half the central one So, for the first time we were now able to get polarised radiations from the molecules of a gas All attempts to produce such simple vibrations from gaseous molecules had hitherto failed

With some lines the central component and the outer ones differ much in intensity If this be the case the spectroscope can be dispensed with entirely, and we may observe a partial polarisation of the light emitted by the vapour in the field as found by Egoroff and Georgiewsky We shall now consider the light emitted in the direction of the lines of force (Fig 4)

It is seen at once that each line must split up into two components Moreover, both lines must be circularly polarised, but in opposite directions With suitable arrangements, in one half of the field of view the one in the other the second, component can now be extinguished I observed this circular polarisation for the first time in the case of the sodium lines now shown You see how complete the circular polarisation is There is no trace of rectilinear or of elliptic polarisation[4]

When I first looked for this circular polarisation, I did not have the field of view divided into two parts, but the position of the line was determined by means of a spider's thread On the reversal of the magnetising current the luminous line moved I do not wish to disguise the fact that no observation has ever afforded me so much pleasure as this one

It has already been remarked that we can also study the absorption lines which become visible when white

FIG

light is transmitted through the vapour We then study the inverse effect I shall use it to show you at least something directly depending upon the effect, because the effect itself is too young to appear before so large an audience The inverse effect for light parallel to the lines of force plays a part in an experiment due to Righi[1] Consider a horizontal ray parallel to the axis of an electromagnet with pierced poles, and let crossed Nicols be placed

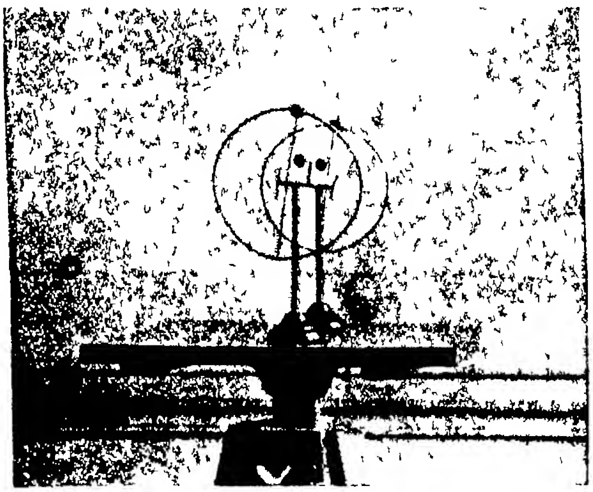


FIG 4

before and behind the instrument, as in Faraday's experiment A sodium flame in the field emitting two kinds of circularly polarised rays absorbs these same radiations but does not stop the radiations polarised in the opposite

[1] Zeeman, Verslagen Kon Akademie v Wetenschappen Amsterdam Mei, Juni, October, 1897 *Phil Mag* July and September, 1897

[2] The photographs illustrating this lecture are excepting the diagrams, enlarged copies from negatives. The scale is different in the various cases The separation of the outer components is of the order of one sixth of the distance of the sodium lines (the vertical lines in Fig 5) No 2 is a copy of one of the first photographs I obtained The author is indebted to Prof Runge for No 11 The ronet is not distinctly shown in the latter reproduction In the Proceedings of the Royal Institution some additional Figs will be reproduced

[3] Lorentz, *Annalen der Physik*, Bd 63, p 278, 1897

[4] *Cf* Larmor, "Aether and Matter," p 345, 1900.

[1] Righi, *C R*, cxxvii, p 216, 1898 *C R* cxxviii p 45 1899 *Nuovo Cim* (9), 8, p 102 1898

direction These remaining circularly polarised rays cannot be extinguished by a Nicol

The brilliant yellow spot which appears on the screen as soon as the current is put on is due to such rays The explanation of this experiment is not complete, however, at least not for denser vapours The Faraday rotation of the plane of polarisation then plays a part, as we shall see further on

The magnetisation of the spectral lines allows us to determine whether positive or negative electrons are vibrating in a flame From the phenomena in the direction of the lines of force, it follows that in a luminous gas *the negative* electrons give rise to all vibrations It does not follow, however, that the luminous molecules have a negative charge On the contrary, the researches of Lenard and Stark show that at least part of the luminous spectra is emitted by positively charged atoms

When a line is split up into a triplet, we can, by measuring the amount of the effect, find out how much matter is loaded with the revolving electron, or, in other words, we can determine the ratio of the charge e to the mass m of the electron In this manner I have made the *first determination of this notable number* e/m, *and* found it of the order of magnitude of 10^7 electromagnetic units per gram [1] The most accurate measurements of the present time for different spectral lines yield values ranging between 1 4 and 1 8 by 10^7 This number is about 1500 times the corresponding number for hydrogen as deduced from the phenomena of electrolysis

We must, then, conclude that at least a majority of spectral lines is due to the vibrations of the negative electron This conclusion is not only valid for incandescent sodium or mercury All elements which can give colour to a flame or which can be evaporated in a spark show the magnetisation of the spectral lines, and hence in all elements these negative electrons are present

Independent experimental evidence for the existence of electrons has been derived from the study of the kathode rays in a vacuum tube The discontinuous structure of electricity was also proved by other phenomena, and in this way physicists were led by purely experimental methods to the negatively charged corpuscle of J J Thomson, 1500 times smaller than the hydrogen atom, in full accordance with the electron necessitated for the explanation of the magnetisation of the spectral lines

All fundamental characteristics of the magnetic resolution of the spectral lines were then explained, and the truth of the explanation proved beyond the possibility of doubt More detailed knowledge of the effect has been greatly extended by a whole series of investigators, especially by Becquerel, Cornu, Cotton Michelson, Kent, Konig, Righi, Reese, Runge and Paschen, and in this country by Gray, Preston, Lodge, Lord Blythswood, and others, and from the theoretical side by Larmor, Fitzgerald, Jeans and J J Thomson

Not all spectral lines are tripled, some are split up into quartets, others into sextets The lines D_1 and D_2 in strong fields are an example The whole of such a system of lines is, even in the strongest fields, confined to the space of one-sixth of the distance of the sodium lines In some cases still more complicated subdivisions have been observed, especially by Michelson In such cases the simple electromagnetic model of a molecule emitting light is insufficient We shall return to this subject afterwards, and first proceed to a discussion of *phenomena accompanying the inverse effect*

This investigation, which I carried out in Amsterdam together with my pupils, Drs Hallo and Geest, was suggested by a theoretical investigation by Prof Voigt, of Gottingen Lorentz's theory relates to one single vibrating particle, and can only be applied to substances of very small density which emit very narrow spectral lines With greater density, and therefore broader spectral lines, the mutual influence of the molecules must be taken into account It seems, however, that a theory of emission of a system of reciprocally reacting molecules is rather difficult In the case of absorption the problem is easier, and is considered by Prof Voigt in his theory of magneto-optical phenomena [1] He does not deal with the electrons directly, but adds suitable new terms to the equations of motion in an absorbing medium. His method establishes a connection between the rotation of the plane of polarisation and the resolution of the spectral lines, a connection almost simultaneously pointed out by Fitzgerald. This also led to an interesting result, until then missed by the electronic theory, namely, rotation of the plane of polarisation close to an absorption band

[1] Zeeman, Verslagen Kon Akademie, Amsterdam, November, 1896, § 23

[1] Voigt, *Annalen der Physik*, Bd 67, S. 345, 1899.

(*To be continued*)

MINERAL RESOURCES OF THE UNITED STATES.

FROM time to time we have directed attention to the variety and magnitude of the work being carried on by the United States Geological Survey Of all the work undertaken, none is of greater value to the general public than that of the division of mining and mineral statistics under the able direction of Dr David T Day, whose masterly report (Washington, 1905) on the mineral resources of the United States for 1904 has recently been issued The volume covers 1264 closely printed pages, and in arrangement and scope is similar to the twenty preceding annual reports of the series Each chapter is a census of the productive features of the industry under discussion from the pens of statistical experts The figures dealt with are stupendous. In 1904, for the fifth time, the total value of the mineral production of the United States exceeded the sum of 200,000,000*l*, and it is curious to note that the value of non-metallic minerals exceeded that of metallic minerals by 41,000,000*l* Iron ore and coal are the most important of the mineral products Statistics of the production of moulding sand were collected for the first time in 1904. Another novelty is a report, written by Mr H H Hindshaw, directing attention to the occurrence of peat in the United States and to its possibilities as a source of fuel Appended to the report is a useful bibliography of the subject Tin ore was produced commercially, though in small quantities, in South Carolina South Dakota, and Alaska

There is a constant increase in the demand for such abrasives as corundum and emery, and consequently the publication of Bulletin No 269 (Washington, 1906), on corundum and its occurrence and distribution in the United States, by Mr J H Pratt, is a welcome addition to technical literature It is an enlarged edition of Bulletin No 180, published in 1901, and has grown from 98 pages to 175 pages It is admirably illustrated with eighteen plates, and constitutes a complete monograph on the three varieties, sapphire or gem corundum, corundum, and emery All the occurrences in the United States are described, and particulars are added regarding the distribution of corundum in other countries, the methods of mining and cleaning, and the uses of corundum In conclusion, some useful suggestions to prospectors for chromium are given

The most remarkable outcome of the recent work of the mining division is the extensive series of tests of the various coals found in the United States These are recorded in three bulky quarto volumes forming Professional Paper No 48 (Washington, 1906), and covering 1492 pages The work was carried out at the coal-testing plant of the United States Geological Survey at the St Louis Exhibition under the direction of a committee consisting of Messrs Edward W Parker, Joseph A Holmes, and Marius R Campbell The first volume describes the field work, classification of coals, and chemical work, the second deals with boiler tests, and the third with producer-gas, coking, briquetting, and washing tests The results are of far-reaching importance in the solution of the fuel and power problems upon which the varied industries of the United States depend Most of the American bituminous coals and lignites can, it was found, be used as a source of power in a gas-producing plant, the power efficiency of bituminous coals when thus used being two and a half times greater than

their efficiency when used in a steam-boiler plant Some of the lignites from undeveloped, but extensive, deposits in North Dakota and Texas showed unexpectedly high power-producing qualities, and it is shown that certain of the dry, non-coking, bituminous coals and semi-anthracites, which are now almost wasted, can be converted into useful fuel by briquetting The work of the chemical laboratory in connection with the sampling of the coal has undoubtedly set a standard for similar work in the future The total sum appropriated for the work by the United States Government was 12,000*l*

The United States Geological Survey has undertaken a far-reaching investigation of all the lead and zinc deposits in the Mississippi valley. A large part of this field has been investigated by the Wisconsin Geological Survey, and an interesting report on the ore deposits, with an atlas of eighteen detailed maps, has been published by Mr U S Grant (Bulletin No xiv, Madison, Wisconsin, 1906) The results brought out by these maps in regard to the relations and origin of the ore are extremely satisfactory, in that they show that a large portion of the ore deposits are confined to the structural basins

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Cambridge —The voting on the proposed new regulations for the mathematical tripos will take place at a Congregation to be held on Friday and Saturday, February 1 and 2, 1907.

The general board of studies has recommended (1) that a university lecturer in hygiene be appointed, in connection with the special board for medicine, with an annual stipend of 100*l* payable out of the funds in the hands of the State Medicine Syndicate, (2) that a university lecturer in pathology be appointed, in connection with the special board for medicine, with an annual stipend of 100*l* payable out of the common university fund

The general board of studies has approved Mr E W Barnes, Trinity College, for the degree of Doctor in Science

Prof M E Sadler will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 20

Lord Monkswell will distribute the prizes and certificates to students at the Borough Polytechnic Institute on Tuesday, December 11, at 8 p m

A gift having the annual value of 500*l* a year has been made to the University of Paris by Mr Andrew Carnegie for scholarships to be awarded for the purpose of carrying on research in the laboratory of Mme Curie

A statue of the late Principal Viriamu Jones, F R S, first principal of the University College of South Wales and Monmouthshire, and the first senior Vice-Chancellor of the University of Wales, was unveiled at Cardiff, on December 1, by Viscount Tredegar

A deputation from the executive of the Association of Education Committees was received by Mr Birrell at the Board of Education on November 29 The deputation sought to obtain more elasticity in the local development of higher education, greater freedom for local education authorities in the training of teachers, and increased Imperial aid for the relief of education rates Mr Birrell, in reply, expressed his sympathy with the ideals and most of the objects of the association, and his regret that the Treasury could not authorise him to promise at present any further grant of public funds in relief of local education rates

An unusually interesting and important Blue-book (Cd 3255) has just been issued by the Board of Education. It deals with statistics of public education in England and Wales for the years 1904–5–6 Every grade of school is dealt with, and it is now easy to trace the growth of educational enterprise in recent years One of the numerous sections is devoted to technical institutions, that is, as defined by the regulations of the Board, to institutions giving organised courses of instruction in day classes In 1904–5 twenty-three such institutions only were recognised, 2509 students attended them at some time during the year, grants amounting to 8542*l* were paid on 1295 students attending a full course of instruction, and 1507*l* on 489 students attending part only of a course Small as these numbers are, it is satisfactory to find they are larger than the corresponding figures for 1903–4 These students were taught by 416 teachers, of whom nine were women, numbers representing an increase of 108 in the teaching staff in the year The average age of the students attending these classes was rather low Of the total number of students, under 300 were women and girls, 1136 were between fifteen and eighteen years of age, 879 between eighteen and twenty-one, and 494 were more than twenty-one years of age Courses of work in engineering and in applied chemistry were most numerous During 1904–5 the number of evening schools recognised reached 5706 and the number of students who attended at any time during the year 718,562, a grant was paid on 487,699 of the total number of students The amount of the grant reached 320,762*l* Of this total number of students as many as 155,938 were under fifteen years of age, and 202,707 were more than twenty-one years Two-thirds of the students were men or boys This Blue-book will prove indispensable to educational administrators everywhere

The scholarships, medals, and prizes gained by candidates at the examinations of the London Chamber of Commerce were distributed on November 30 by Mr Asquith, Chancellor of the Exchequer, who subsequently delivered an address After referring to the growth of the educational work of the Chamber of Commerce, Mr Asquith said that men and women of all classes and schools of opinion must agree in feeling gratification that during the last twenty or thirty years we have by our continuation classes, by our technical classes, by our polytechnics, been endeavouring, at any rate, to superadd to the common basis of education which was the possession, or ought to be the possession, of all classes of the community, some means of equipping men and women for the special exigencies of the particular branches of their profession in life The English people, who have some very excellent qualities, have some ingrained and almost ineradicable superstitions All agree that in the case of what are called the learned professions some kind of special training and knowledge is needed before a man takes upon himself the pursuit of his calling in them, but every Englishman thinks he is perfectly qualified to take up without any preliminary training the work of business But Mr Asquith continued, we cannot now take things in the easy-going and the happy-go-lucky fashion that we used to do The strain of foreign competition presses upon us in every walk of business and every market in the world, and, whatever are the contributory causes of the pressure which we all in a greater or less degree experience there is not a man acquainted with the facts who will not agree that in the case, at any rate, of some of our most formidable competitors—for instance Germany and the United States—one of the great sources from which they have derived exceptional strength in their commercial and industrial struggle with us has been the superior development of their technical and educational system

SOCIETIES AND ACADEMIES

London

Royal Society, June 21 —"The Action of Radium and Certain other Salts on Gelatin" By W A Douglas **Rudge.** Communicated by Prof J J Thomson, F R S

The author has completed his experiments on the above subject, following the method first described in Nature (vol lxxii, p 631) A "growth" which appears cellular in structure is seen to occur when a radium salt is put in contact with gelatin This growth is traced to the formation of an insoluble precipitate of barium sulphate owing to the barium always associated with radium salts and the sulphuric acid usually present in commercial samples of gelatin Specially prepared gelatin containing no sulphuric acid gives no growth

A sample of gelatin from which the sulphuric acid had

been removed was sealed up with some radium salt in September last, and at the present time no signs of growth have made their appearance, but if to a portion of the gelatin a soluble sulphate is added a growth at once appears

A series of photographs has been taken by means of the large photomicrographic apparatus of Zeiss, using magnifying powers of from 400 to 4000 diameters

It thus seems to be quite clear that the cellular growth cannot be produced by radium or barium unless a sulphate is present, and other metals, save Sr and Pb, fail to produce any result, because they do not form insoluble sulphates

The cellular form of these precipitates is probably due to the circumstance that the gelatin is liquefied by the actions of the salt, and each particle of precipitate is formed about a core of gelatin, so that the layer of barium sulphate forms a kind of sac or cell which is surrounded by the solutions of the salt in the liquefied gelatin This *cell* may be permeable to the liquefied gelatin containing a salt in solution which, passing through the cell wall, causes an expansion to take place, the limit of growth being controlled by some surface-tension effect

The conclusions which are drawn from a study of the photographs and direct examination under the microscope with high powers are that —

(1) The cells form round a precipitate of an insoluble sulphate and the energy of the growth of the cell depends upon the amount of sulphate present

(2) *Radium has no specific action in forming cells* any effect produced being due to the barium associated with it, and the purer specimens of radium salts are less satisfactory as cell-formers than the impurer ones Probably pure radium salt would have no action except that of causing an evolution of gas

(3) The cells do not divide or bud, or show anything resembling "karyokinesis," their growth very quickly reaches a maximum, and they do not decay or split up, save as a consequence of the drying of the gelatin If the cover glass is sealed down with cement, the cells have been observed to suffer no alteration in the course of four months

(4) Radio-active substances, unless they contain barium, do not give rise to the formation of cells

November 1 — "The Anæsthetic and Lethal Quantity of Chloroform in the Blood" By Dr George A **Buckmaster** and J A **Gardner** Communicated by Dr A D Waller, F R S

The amount of chloroform present in the arterial blood of animals at various stages of anæsthesia has been accurately determined by the authors for the first time in this country All observers who have worked at the question of chloroform-anæsthesia, including those members of the Special Chloroform Committee of the British Medical Association who have specially investigated this point, are agreed that chloroform is tenaciously held by blood, and that the transport of the drug from alveolar air to the cells of the body and the nervous system is probably effected by the red corpuscles

The authors have given in some detail an account of the researches recently undertaken by French observers J Tissot and Mansion, and M Nicloux who have improved on the original methods employed by Gréhant and Pohl by using the reaction described by Dumas in 1821 To ascertain the amount of chloroform in blood, this is distilled off from the liquid, boiled with alcoholic potash, and the potassium chlorate thus obtained is titrated with silver nitrate

In the experiments now described, the amount of chloroform in arterial blood at the moment when both the conjunctival and tail reflexes have disappeared, when the respiratory movements cease, and when the reflexes reappear, has been calculated from the difference in the chlorine-content of the blood before and after the administration of the anæsthesia The method of estimation was the well-known one introduced by Carius for determining the amount of halogen in organic compounds and by the adoption of Gooch's method of filtration and J P Cooke's suggestion of washing the silver chloride precipitate with water containing a little silver nitrate, a very high degree of accuracy was obtained. For the validity of this method the natural chlorine-content of the blood must be shown to remain constant during the course of any single set of experiments Several tables show that this is the case during prolonged anæsthetisation with ether, the actual deviations from the mean being only 0·00123 and 0·00165.

The majority of the observations have been made on cats, since the phenomena of anæsthesia in these animals closely resemble those observed in man In order to afford a means of comparison with the results obtained by the French observers on dogs, a few experiments were carried out on these animals

Since it is difficult in any given case to ascertain the exact moment when an animal is actually anæsthetised, the authors have been obliged to take the disappearance of both conjunctival reflexes as a fixed point, and the occurrence of the first asphyxial convulsion of the respiratory muscles as indicative of the lethal stage, and in order to obtain comparable results they have found that the experiments must be made on healthy, well-nourished adults and that the animals must not be in full digestion

From the results of all the experiments it has been found that the amount of chloroform in arterial blood at the moment when the conjunctival reflexes disappear varies between 14 and 27·6 milligrams in 100 grams of blood As others have noticed, the rate of induction of anæsthesia varies slightly in different animals, though the actual body-weight is a negligible factor The curves given in the paper, which have been constructed from the varying chloroform-content of the blood during anæsthesia, show that the rate of induction is a feature peculiar to each *individual animal* The average lethal dose of chloroform in 100 grams of blood is 40 milligrams

After anæsthesia the chloroform is eliminated with extreme rapidity, and though the rate of elimination varies in different animals, the rate of disappearance of chloroform is far more constant than the rate of assumption

A considerable number of experiments devised to ascertain how chloroform when inhaled is distributed in the red corpuscles and plasma show that the drug is primarily associated with the corpuscles, and only gets into the plasma when the anæsthesia is pushed to an extreme point or a high percentage of the vapour is rapidly administered From the results given in Table xvii it appears that no less than 98·5 of the total chloroform in the blood was held by the corpuscles at the moment when the respiration ceased

The view of Desgrez and Nicloux that carbon monoxide is formed in the blood during intense chloroform-narcosis has not been verified by the few observations which were made to determine this particular point

November 8 — "Experimental Investigation as to Dependence of Gravity on Temperature" By L **Southerns**. Communicated by Prof W M Hicks, F R S

The object of this investigation is to determine whether the action of gravity on a given mass varies to any measurable extent when the temperature of the mass is altered Experiments having the same object, but differently carried out, were described by Poynting and Phillips in the Proceedings of the Royal Society, September 1905 about a year after the commencement of the present work These led to a null result, which receives confirmation from the experiments here noticed

The apparatus in its original form was constructed several years ago by Dr Hicks After some modification it was set up in the new university buildings at Sheffield A mass of paraffin oil was used in the experiments This was contained in an air-tight, jacketed calorimeter, and suspended from one end of the beam of a balance, the other end carrying a suitable counterpoise A coil of fine platinum wire was immersed in the oil, and by passing through this an alternating current, the temperature of the oil could be raised to the required degree In order that this might be accomplished while the balance was freely suspended on its knife-edges, the current was conveyed to the coil by means of two wires rigidly fixed to the beam, their ends being pointed and made just to dip into mercury cups which were placed in line with the central knife-edges, and were joined up to the external circuit The connections between the wires and

the coil leads consisted of thin strips of tinfoil The error caused by the expansion of these wires due to the passage of the current was negligibly small The balance was enclosed in a partially exhausted box, the weighings being carried out under a pressure of from 6 cm to 5 cm of mercury.

The experiment consisted in observing (by means of telescope and scale, and a mirror attached to the beam) the equilibrium position of the beam before heating the mass of oil, and noting any deflection of the same which might occur during and after the passage of the heating current. Only very minute, transient deflections were obtained, and as these did not persist it was evident that they could not be due to actual alterations of weight due to rise of temperature The results seem to show that no variation of weight greater than 1 in 10^8 occurs during an increase of temperature of 1° C for the substance used in the experiments

Geological Society, November 7 —Sir Archibald Geikie, Sec R S, president, in the chair —The Upper Carboniferous rocks of west Devon and north Cornwall E A Newell **Arber** After a reference to the previous work in the area the author gives a description of the coast-sections, which display a highly-disturbed sequence of Upper Carboniferous rocks Special attention is paid to two lithological types the Carbonaceous rocks, which contain inconstant and impersistent beds of the impure, smutty coal, known locally as "culm", these beds have yielded plant-remains, and the Calcareous rocks, partly of marine and partly of freshwater origin, consisting of well-marked, impersistent bands of impure limestone, and conglomeratic beds of calcareous nodules embedded in shales One of the limestone-bands, the Mouthmill Limestone, is marine, and contains an abundant fauna, while in others the only fossils are *Calamites suckowi* and *Alethopteris lonchitica* Two distinct and unmingled faunas are present in the rocks one consists of fresh-water lamellibranchs, and the other of marine fishes, cephalopods, and lamellibranchs, and the evidence as to horizon obtained from them agrees with that yielded by the plant-remains —The titaniferous basalts of the western Mediterranean Dr H S **Washington** In 1905 the author visited the volcanic districts of Catalonia Sardinia, Pantelleria, and Linosa He recognises the existence in this region of a hitherto unrecognised petrographic province, in which the basalts contain a remarkably high percentage of titanium The rocks are of Tertiary age Labradorite, augite, and olivine are the essential minerals, with titaniferous magnetite and apatite, and in some cases subordinate nepheline The extent of the region is as yet problematical, and the author points out that along the southern coast of France there are several "basaltic" volcanoes, and it is possible that these may eventually turn out to be connecting links between the rocks of Sardinia and those of Catalonia, or possibly extrusion southward is indicated by the occurrence of phonolite at Maid Gharian, near Tripoli

Royal Astronomical Society, November 9 —Mr W H Maw president, in the chair —Account of recent work at the Royal Observatory, Cape of Good Hope Sir D **Gill** —The systematic motions of the stars A S **Eddington.** The author's conclusions supported Kapteyn's hypothesis that there exist two drifts of stars, one drift moves relatively to the sun with a speed between three and four times that of the other, and the numbers of the stars in each drift are nearly equal —The irregular movement of the earth's axis of rotation a contribution towards the analysis of its causes Prof J **Larmor** and Major F H **Hills.** The movement of the earth's axis of rotation is compounded of a "free precessional" period of 428 days, with irregular disturbances superimposed The authors give a graphical method of setting out the direction and magnitude of the forces giving rise to the irregular disturbance, and hence arriving at its cause The curve representing the movement of the pole about its mean position is first referred to an axis revolving in a period of 428 days The hodograph of the derived curve is constructed, and this is transferred into the corresponding hodograph referred to axes fixed in the earth The last curve then becomes a "torque diagram," showing in direction and relative magnitude the couple or torque acting upon the earth's axis at any date which would account for the observed motion of the pole The forces to which these torques are due may be either internal or external transfer of material on the earth, the latter being in the form of change of ocean level, melting of polar ice, earth quake disturbances, or changes of barometric pressure A numerical estimate of the possible amount of shift due to these various causes was given —The distribution of energy in the continuous spectrum The resolving power of spectroscopes E T **Whittaker**

Physical Society, November 9 —Prof J Perry, F R S, president, in the chair —Exhibition and description of apparatus for students' practical work in physics G F C **Searle.**

PARIS

Academy of Sciences, November 26 —M H Poincaré in the chair —The determination of the integrals of certain partial differential equations by the values of the normal differential coefficients along a contour Emile **Picard** —The alcoholysis of cocoa butter A **Haller** and M **Youssoufian** Three kilograms of cocoa butter were submitted to the action of methyl alcohol in the presence of either hydrochloric or phenylsulphonic acid, and the methyl esters separated by fractional distillation under reduced pressure The methyl esters of caproic, caprylic, capric, lauric, myristic, palmitic, stearic, and oleic acids were separated and identified Butyric acid was carefully searched for but not found —Some remarks on the observations of contacts in total eclipses of the sun Ch **André.** It is shown that the perfect concordance between the times observed at the same place for the same contact by two different observers does not prove that this result is the real time of contact A correction is necessary, depending on the observer and the aperture employed —The history of the principle employed in statics by Torricelli P **Duhem** —An improvement in the eudiometer its transformation into a grisoumeter Detection and estimation of methane and carbon monoxide Nestor **Gréhant.** The fine platinum wire first introduced by Coquillion as a means of combustion of gases, is fitted to the graduated tube by means of a rubber cork The wire is heated to redness from two to six hundred times In a 1 per cent mixture of methane and air, 0.92 per cent was found by this improved method or an accuracy of 92 per cent of the amount present The determination of the geographical coordinates of Tortosa and of the new Ebro Observatory R **Cirera.** -Partial differential equations of the second order with two independent variables admitting a group of even order of transformations of contact J **Clairin** —The integration of differential equations J **Le Roux.**—The electrical conductivity of selenium Maurice **Coste** From the point of view of electrical conductivity light produces the same effect on selenium as a rise of temperature A specimen of selenium possessing a large residual conductivity is insensible to the action of light — A mode of preparation of hydrated hypovanadic acid Gustave **Gain** Ammonium metavanadate is gently ignited at a low temperature and the resulting mixture of V_2O_5 and V_2O_4 placed in a stoppered flask with an excess of saturated sulphurous acid solution The blue solution thus obtained is submitted to prolonged ebullition, when the acid H_2VO_3 is deposited —The elements producing phosphorescence in minerals The case of chlorophane, a variety of fluorspar G **Urbain** By converting the fluoride into oxide and examining the kathode spectrum of the phosphorescent line thus obtained traces of the rare earths, including samarium, terbium, dysprosium and gadolinium have been detected —The oxide-ethers of glycollic nitrile Marcel **Sommelet** —The transformation of cinnamic alcohol into phenylpropylene and phenylpropyl alcohol by the metal-ammoniums I **Chablay** The metal-ammoniums reduce cinnamic alcohol in a similar manner to the unsaturated fatty alcohols giving the corresponding hydrocarbon and according to the same mechanism, but the yield is very poor the principal reaction being the production of phenylpropiolic alcohol — A method of preparing the oxynitriles RO CH CN D **Gauthier** The monochlor-ethers R O CH_2Cl are readily prepared by Henry's method the reaction of hydrochloric acid upon a mixture of the alcohol ROH and formaldehyde

in aqueous solution The chlorine atom in these compounds is readily exchanged for the cyanogen group by treating with mercury, or, better, cuprous cyanide An account is given of the preparation and properties of several nitriles by this method —Vicianine, a new cyanogenetic glucoside contained in vetch seeds Gabriel **Bertrand** Full details are given of the method adopted for extracting the glucoside from the seed Vicianine contains 3 2 per cent of nitrogen the whole of which is set free as hydrocyanic acid by the action of emulsin - Cytological observations on the germination of the seeds of Gramineaceæ A **Guilliermond** —The concentration of chlorophyll and assimilating energy W **Lubimenko** —A disease of *Abies pectinata*, accompanied by a reddening of the leaves L **Mangin** and P **Hariot**. Several species of fungi were found on the infected leaves, and it is not yet clear to which of these the disease is due To settle this point, inoculation tests with the various spores isolated will be carried out in the Cryptogam garden - The culture of the artificial cell Stéphane **Leduc** Experiments on the structures formed by a grain of copper sulphate placed in an aqueous solution containing from 2 per cent to 4 per cent of potassium ferrocyanide 1 per cent to 18 per cent of sodium chloride or other salts, and from 1 per cent to 4 per cent of gelatin The granule becomes surrounded by a membrane of copper ferrocyanide permeable to water and certain ions but impermeable to sugar It is shown that the products of growth of these artificial seeds are sensitive to all chemical and physical actions The growth is arrested by numerous poisons and the direction of growth is determined by differences of temperature and osmotic pressure —The action of *Exophyes passerinae* on the leaves of *Giardia hirsuta* C **Gerber** —The *rôle* of olefaction in the recognition of ants H **Piéron** —Experimental researches on thermal troubles in cases of absolute privation of sleep N **Vaschide** The privation of sleep induces a constant and sensible lowering of the body temperature The first physiological effect of sleep is to restore the thermal equilibrium of the organism —The physiological *rôle* of the yellow pigment of the macula A **Polack** Contribution to the study of the hearing of fishes M **Marage** Fishes do not hear vowel sounds transmitted in the interior of the liquid even although the energy of the sound is sufficiently great to be remarked by persons regarded as completely deaf Experimental researches on the lesions of the nervous centres following on insolation G **Marinesco**

DIARY OF SOCIETIES.

THURSDAY DECEMBER 6

ROYAL SOCIETY at 4 30 —A Comparison of Values of the Magnetic Elements deduced from the British Magnetic Survey of 1891 with Recent Observation W Ellis F R S —The Theory of the Compositions of Numbers Part ii Major P A MacMahon F R S On the Transpiration Current in Plants Prof H H Dixon —The Theory of Photographic Processes Part iii, The Latent Image and its Destruction S E Sheppard and C F K Mees The Chemistry of Globulin W Sutherland

CHEMICAL SOCIETY at 8 30 —The Liquid Volume of a Dissolved Substance J S Lumsden - Some Derivatives of Benzophenone Synthesis of Substances occurring in Coco bark (preliminary notice) W H Perkin jun and R Robinson —A Synthesis of Terebic Terpenylic and Homoterpenylic Acids J I Simonsen

LINNEAN SOCIETY at 8 —*Papers* A Contribution to the Physiology of the Museum Beetle *Anthrenus museorum* (Linn) Prof A Ewart —Note on the Origin of the Name *Chermes* or *Kermes* E R Burdon —*Exhibitions* An Abnormal Specimen of a Dab with Three Eyes Dr A T Masterman —A Note on *Siegesbeckia orientalis* Linn Rev H Purefoy FitzGerald

INSTITUTION OF ELECTRICAL ENGINEERS at 8 Selection and Testing of Materials for Construction of Electric Machinery Prof J Epstein

FRIDAY DECEMBER 7

GEOLOGISTS ASSOCIATION at 8 —The Zones of the White Chalk of the English Coast Part v Isle of Wight Dr A W Rowe

AËRONAUTICAL SOCIETY, at 8 —The Use of the Kite in Meteorological Research Dr W N Shaw F R S —The Gordon Bennett International Balloon Race Colonel J F Capper —The Aëroplane Experiments of M Santos Dumont E S Bruce —The Stability of the Conic Shape in Kites and Flying Machines R M Balston.—*Exhibit* A Model of the Santos Dumont Aeroplane, made by the President

MONDAY, DECEMBER 10

VICTORIA INSTITUTE, at 4 30 —Review of Prof Flinders Petrie's "Sinai The Secretary

ROYAL GEOGRAPHICAL SOCIETY at 8 30 —Irrigation in the United States its Geographical and Economical Results Major John H Beacom

SOCIETY OF ARTS, at 8 —Artificial Fertilisers Phosphatic Fertilisers A D Hall

TUESDAY, DECEMBER 11

ZOOLOGICAL SOCIETY, at 8 30

INSTITUTION OF CIVIL ENGINEERS, at 8 —*Discussion* The Talla Water supply of the Edinburgh and District Waterworks, Repairing a Limestone concrete Aqueduct and The Yield of Catchment Areas.—*Probable Paper* Mechanical Considerations in the Design of High tension Switchgear H W E Le Fanu

FARADAY SOCIETY at 8.—(1) On the Electrochemistry of Lead, (2) Contributions to the Study of Strong Electrolytes Dr A C C Cumming —Storage Batteries and their Electrolytes, Part ii R W Vicarey

WEDNESDAY, DECEMBER 12

SOCIETY OF ARTS, at 8 —Fruit Growing and Protection of Birds Cecil H Hooper

THURSDAY, DECEMBER 13

ROYAL SOCIETY, at 4 30 —*Probable Papers* On the Intensity of Light Reflected from Transparent Substances Prof R C Maclaurin Contributions to our Knowledge of the Poison Plants of Western Australia, Part ii, *Oxylobium parviflorum* Lobine E A Mann and Dr W H Ince —Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases F W Aston —An Examination of the Lighter Constituents of Air J E Coates —Further Observations on the Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness H G Plimmer

SOCIETY OF ARTS, at 4 30 —The Indian Mohammedans their Past, Present and Future A Yusuf Ali

LONDON INSTITUTION at 6.—Tadpoles—a Study in Embryology Dr J W Jenkinson

MATHEMATICAL SOCIETY at 5 30 —On the Form of the Surface of a Search light Reflector C S Jackson —The Potential Equation and Others with Function given on the Boundary L F Richardson —On the Limits of Real Variants J Mercer —The Asymptotic Expansion of Integral Functions defined by Generalised Hypergeometric Series Rev E W Barnes.—The Diophantine Equation $x^n - Ny^n = z$ Major P A MacMahon

FRIDAY, DECEMBER 14

PHYSICAL SOCIETY, 7 p m to 10 p m.—Second Annual Exhibition of Electrical, Optical, and other Physical Apparatus

ROYAL ASTRONOMICAL SOCIETY at 5

INSTITUTION OF CIVIL ENGINEERS at 8 —Mechanical Improvements in the Drainage of the Bedford Level A Carmichael

INSTITUTION OF MECHANICAL ENGINEERS at 8

MALACOLOGICAL SOCIETY, at 8 —Description of *Latirus* (*Peristernia*) *Sowerbyi* sp n J Cosmo Melvill —On the Anatomy of *Tagelus gibbus* and *T divisus* H H Bloomer —Descriptions of two New Helicoid Forms from German New Guinea J H Ponsonby

CONTENTS.

THURSDAY, DECEMBER 13, 1906

THE USE OF PRESERVATIVES

Preservatives in Food and Food Examination By Dr. John C Thresh and Dr A E Porter. Pp xvi+484 (London: J. and A Churchill, 1906) Price 14s net

THERE is much knowledge enshrined in Parliamentary Blue-books, and doubtless some wisdom Very often it remains enshrined in them. A better fate, however, has awaited the report of the Departmental Committee appointed by the President of the Local Government Board in 1899 "to inquire into the use of preservatives and colouring-matters in food-stuffs" Messrs Thresh and Porter have taken this report partly as text, partly as sermon, amplifying it here, compressing it there, and adding, moreover, various allied matters not directly within the purview of the committee, they have produced a volume which will probably be consulted by hygienists when the original Blue-book lies almost forgotten in the archives of the Parliamentary bookseller

The matter is classified into five parts In the first section the authors deal with the various methods adopted for preserving foods and give a general description of preservatives, their pharmacological effects, and the experimental work which has been done upon them For example, Wiley's investigation into the effects of boron compounds upon the human system is summarised, together with Liebreich's criticism of the results, and due note is made of important experiments by many other workers, including Chittenden, Rideal and Foulerton, Annett, and Tunnicliffe and Rosenheim

The second part is devoted to the principal foodstuffs into which preservatives enter, namely, milk, cream, butter, alcoholic and temperance beverages, fruits, vegetables, meat, eggs, and fish Based upon information contained in the Departmental Committee's report, a short account of the substances is given, with figures showing the quantities of preservative used, and notes of the various circumstances affecting its employment

A perusal of these two sections suggests strongly that the present state of affairs is by no means satisfactory as regards the use of chemical preservatives Our policy has been a haphazard one Preservatives of some kind—*e g* salt and vinegar—have been employed as far back as the memory of man carries us The question is asked, Are these long-known substances the best possible for the purpose? Is it not conceivable that modern chemistry might find something better? Quite possibly it may, in fact so far as indicating antiseptics and germicides is concerned, the task is easy But there is the further question how far any substance which is destructive of microbial and parasitical forms of life may also be inimical to the human organism It is a question of quantity On the one hand we have the advocates of various preserving substances—boric acid, formaldehyde, hydrogen peroxide, sodium fluoride, salicylic, benzoic, formic, and sulphurous acids; asaprol, and so on—who argue (1) that by the use of these and other means of preservation food is rendered cheaper, (2) that definite cases of illness or death have rarely or never been conclusively traced to the use of preservatives, and (3) that, on the contrary, during recent years the death-rate has declined, one of the assignable causes of this being the better feeding of the people resulting from cheaper food. On the other hand, it is urged that many cases of illness have, in fact, been indicated as probably due to preservatives At the best these latter have not been proved harmless, and the most we can admit is that we really do not know what are the physiological effects of small amounts of the foregoing substances But they are certainly harmful if taken in quantity, and may be so in any dose which would be effective as a germicide Moreover, even if strong and healthy adults are unharmed by them, there are still children and invalids to consider Again, it has been pointed out that the uncontrolled employment of preservatives is sometimes liable to great abuse without culpable carelessness on the part of any individual user Boric acid, for example, may be added to milk first by the farmer, again by the wholesale distributer, then by one or more retailers, and possibly again by the consumer himself, and each may add the maximum allowable quantity Generally, it may be said that we rarely or never know how much preservative any given food either ought to contain or does actually contain

The policy of our laws has been to allow food-producers a free hand, subject to the restriction that any preservative added shall not render the food injurious to health But has this *laissez faire* attitude been a wise one? True, it leaves the food manufacturer free to experiment—which is so far, good But it gives him the consumer's living body as *corpus vile*—which is not so good

Naturally the consumer has some right of objection, and in any case the question of what is "injurious to health" has always to be fought out in the police court —about the worst place in which to decide such a matter The most diverse decisions have been arrived at, and meanwhile the query whether or not we and our children are being caused unnecessary suffering remains unanswered

What would be the ideal way of treating such a problem if we could start afresh, and impose decrees *modo tyranni?* Surely it would be to say —Let your salt, vinegar, and such like, as having by long usage proved themselves comparatively harmless, remain as they are Let a responsible body be appointed, competent to examine the newer substances, let it hear what is to be said on either side, and let it make whatever experiments may be necessary and practicable to test the evidence And let no preservative or colouring-matter whatever be added to foodstuffs until it has been at least provisionally approved by this responsible authority

If this course is not practicable in its entirety now that a number of more or less dubious substances have gained something of a footing, it is at least possible to a very considerable extent The authors of the volume before us give both sides of the question very fairly—so fairly indeed that we are often reminded of Mr Facing-both-ways But the impression left by a

careful perusal of their statements is that a competent and impartial body is required to, and could, draw up a schedule of substances and quantities which, on a review of all the evidence, might provisionally be considered as reasonably safe to use. The presumption should be that nothing ought to be added to food until it has been proved harmless, not, as at present, that a manufacturer may add anything he likes until it has been shown to be injurious.

Coming now to the remainder of the volume, colouring matters and mineral poisons, which may occur in food and drink, are dealt with in the third part, and the following section—a long and important one—is devoted to the study of unsound food. Notes on the principal diseases of animals and upon *post-mortem* appearances are appended, and directions are given for the bacteriological examination of shell-fish and of milk and other dairy produce, as also for the detection of toxins and ptomaines in foodstuffs.

The concluding section is devoted to the chemical examination of foods for preservatives and colouring matters, with a chapter on legal points. For the most part the analytical processes described are well-known methods, conveniently collected here, but otherwise calling for no special comment. In passing, however, it may be remarked that mannitol is easier and cleaner to use than glycerol in the volumetric determination of boric acid.

On the whole the volume is a trustworthy production, and may be accepted as the most useful compendium of the subject yet published. C. Simmonds.

MATHEMATICS OF BODILY MOVEMENTS.

Theoretische Grundlagen für eine Mechanik der lebender Körper. By Otto Fischer. Pp. x+372. (Leipzig: B. G. Teubner, 1906.) Price 14 marks.

A FAMILIARITY with the structure of the human body is but rarely combined with a competent knowledge of mathematics. So far as one may judge from published works, Prof. Otto Fischer is the sole representative of this combination of talents in Europe. But his attainments, from their very singularity, carry with them certain disadvantages; although he has diligently applied the methods of the mathematician to the elucidation of the movements of the human body for the last twenty years, he has raised neither rival, disciple, nor critic, his many publications have failed, apparently, to attract the attention of writers of text-books on anatomy and physiology. Prof. Fischer expresses the hope that his book will appeal to mathematicians and physicists on the one hand, and to anatomists and physiologists on the other, he has employed the most intelligible anatomical terms and descriptions for the benefit of the first, and reduced the necessary mathematical formulæ to their simplest expression for the second. Notwithstanding these attempts to form a common ground where mathematicians and anatomists may meet on equal terms, the writer of this notice finds the mathematics of this work difficult and wholly to be taken on trust, and he believes the vast majority of anatomists will experience a similar difficulty. Nor does he believe that the pure mathematician will easily understand the action of such muscles as the "abacus," "short head of the biceps," or "semi-membranosus," nor have a definite conception when he is told that the centre of gravity for the head lies between the "dorsum sellæ" and "posterior perforated lamina."

The initial difficulties which the mathematician and anatomist will experience in studying this book may lead to its great merit being overlooked. In medical text-books the actions of muscles and of joints are described in crude snatches; when the student has finished his study he has no knowledge of the mechanism of the body as a whole. Prof. Fischer's aim is to give a picture of the living, moving body as a complete machine, to estimate the manner in which the muscles work in producing definite movements of the body, and the amount of force expended in the production of these movements. For the purpose of his investigation he has divided the body into fourteen segments or masses, viz. the head, trunk, upper arm, fore arm, hand, thigh, leg, and foot, each of these he treats as a rigid mass; he estimates the centre of gravity for each. The centre of gravity for the trunk he found to be situated near the front of the upper border of the first lumbar vertebra. The mass or weight of each of these parts is estimated, the trunk forming, in the average body, rather more than two-fifths of the whole. The methods applied to the study of machines cannot be used for the human body, where the joints have no fixed axes or fixed points. These difficulties Prof. Fischer seeks to overcome by establishing theoretical fixed axes and fixed points for the various joints, he simplifies his problems, too, by the use of what he terms "mass systems." Although Prof. Fischer has not been altogether successful in reaching the non-mathematical mind, we are certain he has given us in this unique book matter which both physicist and biologist may study with advantage.

GOETHE AS MINERALOGIST AND GEOLOGIST.

Goethes Verhältnis zur Mineralogie und Geognosie. Rede gehalten zur Feier der akademischen Preisverteilung am 16 Juni, 1906. By Dr. G. Linck. Pp. 48. (Jena: G. Fischer, 1906.) Price 2 marks.

THE poetic genius and fascinating personality of Goethe have so dazzled the world that the ordinary reader of "Faust" has never so much as suspected that its author could claim to be a distinguished man of science. Some, perhaps, who have studied the life of the poet may be aware of his discoveries in biology and his speculations in botany, others, again, may have heard of his excursion into the field of optics, and may have marvelled at the amazing aberration of his genius which led him to regard his unhappy attack on the Newtonian theory of colour as the proudest and most valuable achievement of his life; but that he accomplished anything of worth in mineralogy and geology is known to very few.

It is, therefore, well that the professor of mineralogy

and geology at Jena has attempted to do justice to this side of Goethe's activity. Realising the danger of anachronously misrepresenting Goethe's position by attempting to interpret his work in the light of our present knowledge, Prof. Linck has wisely allowed Goethe to explain himself in extracts from his published writings and correspondence. Goethe appears to have been attracted to the study of mineralogy partly by the reopening of the Ilmenau mines and partly through the influence of the Freiberg school. Further, his official position brought him into contact with mining and geological problems, and his business instincts led him to take an interest in any discovery likely to be of practical use.

Goethe, in fact, was by nature a realist, and even his muse was happiest when inspired by a striking event or by a beautiful scene. His realistic tendencies led him to become an ardent collector of minerals, rocks, and fossils, which he regarded from a natural history point of view. But he lived in a time when the classification of minerals by their more obvious external characters and by their mode of occurrence was passing away. On the one hand, analytical chemistry was revealing their composition; on the other, crystallography was reducing to order the apparent complexity of the crystal forms. Goethe, however, held by the old system. He realised, it is true, the importance of chemistry—"I cannot get a step further in mineralogy without chemistry"—but it was a study for which he appears to have had but little aptitude. His appreciation of crystallography was smaller still, witness his statement, "Crystallography is not productive—and leads to no results, especially now that so many isomorphous bodies have been discovered of different compositions." Goethe appears, indeed, to have regarded the progress of these sciences with some misgiving, for he says:—"Mineralogy is in danger of being devoured by crystallography, where form is all important. It is in danger of being devoured by chemistry, which looks only for general laws and is indifferent to form. It may also be in danger of being devoured by geology, for the latter is only concerned with modes of occurrence." As an adherent, then, of a system which had attained practically the fullest development of which it was capable, the field open to him was not extensive, but within its limits he did good work. His description of the Carlsbad felspar twins, for example, was excellent, and we owe many interesting observations to his studies on crystal genesis and on the occurrence and associations of minerals. Among his collections, those from the neighbourhood of Carlsbad were the most important, but Thuringia, the Harz, and Italy were laid under contribution as well, for the mineralogist must be like a stag and browse irrespective of frontiers.

Early in his studies Goethe felt his weakness on the scientific side, and to remedy it caused W. Voigt to be sent to Freiberg. Voigt on his return instructed him in nomenclature, and he began to arrange and label his collections, for "every properly recorded observation is invaluable to posterity." His activity as a collector soon impressed on him the importance of good maps, and the interest thus stimulated led to the preparation of a mineralogical map of the Ilmenau district, subsequently extended to neighbouring regions. It bore further fruit in several practical suggestions as to the best method of printing and colouring such maps. The colour scheme employed to-day is in essentials that proposed by him.

Perhaps Goethe makes his greatest claim to be considered a geologist by his attitude towards the problem of the history of the earth. Living at a time of conflict between Neptunists and Vulcanists, his mind was too well balanced to allow him to become a bigoted partisan or the slave of a hypothesis. The uniformity of nature was his watchword, and he never lost sight of this principle, whether discussing the erratic blocks of Northern Germany or the basalts of Bohemia.

At the conclusion of his review of Goethe's essays in mineralogy and geology, Prof. Linck asks the pertinent question, Are such studies to be put aside with a smile and a shrug of the shoulders as the well meant efforts of an amateur and nothing more? Prof. Linck thinks not. He points out that many contemporaries well qualified to judge thought highly of the work, and he holds that Goethe is justly entitled to an honourable place among the pioneers in mineralogy and geology. We venture to think that anyone who follows the case presented in his pages will endorse his verdict.

THE CHEMICAL STRUCTURE OF CELLULOSE.

Researches on Cellulose. II. (1900–1905.) By C. F. Cross and E. J. Bevan. Pp. xi+184. (London: Longmans, Green and Co.) Price 7s. 6d. net.

IN the course of their extended researches on the chemistry of cellulose the authors of this work have gradually become dissatisfied with all the numerous attempts which have from time to time been made to represent the chemical structure of this substance by means of ordinary constitutional formulæ. The fundamental basis for such a representation, the knowledge of the molecular weight—has always been and is still lacking, and in its absence the chemist has perforce limited himself to endeavouring to assign a chemical constitution to some comparatively small unit containing six or some multiple of six carbon atoms, and has usually regarded the complete unknown molecule of cellulose as a polymeride of this. A certain measure of success has attended these efforts, particularly as regards the relation of the final products of such processes as nitration or hydrolysis to the original unit.

The authors, however, consider all such formulæ to be totally inadequate to express the greater number of the chemical changes which cellulose is capable of undergoing. In place of the purely chemical idea of cellulose as a complex polymeride of preformed groups of rigid configuration, they propose to substitute the conception of cellulose as a colloidal aggregate which may be considered to react "as a labile complex of groups of varying dimensions representing a state of matter somewhat analogous

to that of a saline electrolyte—that is, it reacts rather as a solution-aggregate than by a succession of molecular combinations, the masses actually reacting following the stoichiometrical ratios proper to the dimensions of these ultimate groups, and retaining their relationship in the aggregate, which is thus progressively modified by the entrance of the new groups" (p 7)

Owing to the prevailing ignorance as to the nature of colloids and the relation of this condition of a substance to its chemical character, both the language and the ideas employed by the authors in the development of their thesis are, as they themselves admit, somewhat vague, and it is difficult to realise exactly wherein lies the advantage of the new standpoint over the old view of cellulose as a highly complex molecule, coupled with the recognition of the fact that both the parent substance and many of its derivatives are only known as colloids There can, however, be no doubt that sufficient attention has not hitherto been paid to this cardinal fact of the colloidal character of cellulose, and the authors do good service by insisting upon it and showing very clearly how this conception may serve to suggest many hopeful lines of investigation on questions of scientific and technical importance

The first section of the book contains the development of these ideas, together with a general account of the chemistry of cellulose In the second section are brought together the more important researches on the subject of cellulose which have appeared during the period 1900–5 An impartial abstract of each investigation is given, followed by critical notes on the bearing of the results on the great question of the chemical structure of cellulose The third and concluding section deals with the progress made on the technical side of the subject during the same period This book therefore forms a supplement to the two volumes which have preceded it, but it is valuable, not merely as a compendium of the latest researches on cellulose, but much more as a thoughtful and suggestive contribution to our knowledge of the chemical and physical structure of this important natural product ARTHUR HARDEN

OUR BOOK SHELF

Cours d'Astronomie Première partie Astronomie Théorique By H. Andoyer Pp 221 (Paris A Hermann, 1906) Price 9 francs

THERE is no preface to explain the scope of Prof Andoyer's book, but it appears to consist of the notes of a course of lectures on spherical astronomy Now, it is characteristic of lecture-notes to offer definitions in place of explanations, also, they have a tendency to disintegrate into a bewildering array of unconnected problems The book has these defects But as an exposition of the art of manipulating the very cumbersome formulæ of spherical trigonometry which pervade astronomy, it will fulfil a useful purpose The mathematical treatment is good and concise, moreover, the problems treated are mostly of a severely practical character The author has wisely taken as his guide the Connaissance des Temps, he refers to it continually, and there is very little in the book which has not some direct bearing on the use or construction of its tables

The usual subjects are fully treated, refraction, parallax, aberration, precession, and nutation, there is a brief account of motion in an ellipse. The chapter on the geocentric motions of the planets is not very satisfactory, the student who has followed the lengthy investigations of the preceding chapters might safely have been offered something more advanced and more approximate to the practical problem than the very rudimentary theory here given The apparent motion of satellites is in like manner inadequately treated The last chapter, which deals with eclipses, is, perhaps, the best feature of the book, solar eclipses are treated in a very thorough and interesting way The general accuracy and precision of the book are admirable, the approximations and assumptions made are always clearly stated Occasionally, however, precision is carried to excess, as for instance, when the proper motion of Arcturus is given in seconds per *tropical* year (p. 141)

It is a pity that the book is not *printed* in the usual way It appears to have been reproduced in facsimile from the written manuscript This is a needless sacrifice of clearness, and must to some extent diminish its value as a book for reference A S E

Les Révélations de l'Écriture d'après un Contrôle scientifique By Alfred Binet Pp viii+260 (Paris Félix Alcan, 1906) Price 5 francs

IN this book M Binet, the well-known experimental psychologist of the Sorbonne, describes an investigation of the art of telling intelligence and character from handwriting After some preliminary inquiries to ascertain how far "graphologists" are able to recognise sex and age by means of writing, M Binet submitted to several experts specimens of the handwriting of people of great intellectual eminence, such as Renan, Dumas *fils* and Claude Bernard, together with others obtained from persons known to be of ordinary intelligence The general result was to show that, though the experts were more often right than wrong, they were liable to the grossest errors, as in one case in which Renan was judged to be of mediocre and uncultivated intelligence, an opinion into which the expert appears to have been led by the repetition of a word in the sample

In the estimation of character a similar result was obtained This was tested by submitting to the graphologists specimens of the handwriting of notorious criminals to be distinguished from the writing of people of good moral reputation Here again the experts were usually more or less right, but bad mistakes were made, as when a man who had murdered his mother with every circumstance of brutality was judged to be a young girl, "*douce, modeste, et peu coquette*" In the simple distinction of the two classes of people concerned in the tests, the number of correct answers was distinctly greater than should have been expected from chance, and this preponderance of correct judgments was greater in the estimation of intelligence than in that of character, but it is not clear that clues derived from the subject-matter of the samples of writing were altogether excluded in the former case

In M Binet's hands the graphologists themselves became the subjects of investigation, and it may perhaps be regarded as evidence that their art has a scientific basis that some of the experts showed themselves greatly superior to others, under an experimental procedure which deprived them of many of those adventitious aids on which it is probable they usually rely

The Cyanide Process By Alfred S Miller Second edition, revised and enlarged Pp viii+95, with 29 illustrations (New York John Wiley and Sons; London Chapman and Hall, Ltd, 1906)

THIS little book may be of value in giving general ideas on the cyanide process to those who know nothing about the subject The possessor of the book may be put in a position to understand what is meant by the various phrases with regard to cyaniding that appear in the technical Press It is, however, the least practical of manuals, and its statements, sometimes self-contradictory and sometimes mistaken, must be accepted loosely and generally without too close examination This is the worst that can be said of it, and if it is read cursorily there is no reason for the reader to be misled On the contrary, he may be enabled to converse intelligently on the subject

Highways and Byways in Berkshire By James Edmund Vincent With illustrations by Frederick L Griggs Pp xiii+430 (London Macmillan and Co, Ltd, 1906) Price 6*s*

ALL readers who are familiar with this attractive series will welcome the most recent addition to it The style of production, the illustrations and the spirit of the author will together ensure the volume a wide popularity Mr Vincent is never dull and every aspect of the country side with which he is dealing—be it historical, geological, or sociological—is made to contribute something of interest The book will certainly serve as an invaluable companion to the reader who decides to explore Berkshire for himself, telling him what spots to seek diligently and indicating the districts that may be treated lightly The indolent man, who eschews travel as troublesome, will be able without leaving his armchair by the fire, now that he can have the assistance of Messrs Vincent and Griggs thoroughly to enjoy Berkshire scenes, make the acquaintance of Berkshire men and women and learn the importance of the county in English history

LETTER TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

Geological Survey of Canada

AS one deeply interested in the success of the Geological Survey of Canada, I cannot but regret the letters which have appeared in NATURE concerning the appointment of Mr Low to the directorship of the survey As a result of these letters misapprehensions will certainly remain in the minds of the readers of NATURE concerning this appointment, which it would be impossible to dispel without a detailed statement of the full facts of the case There are however, two statements contained in the letter which appeared in the number of NATURE dated July 12 (vol lxxiv, p 245) which reflect directly on Mr Low's character and standing, and which, in common justice to that gentleman, should not be allowed to pass unchallenged

The first of these statements is that "party politics and not geology have been in question in regard to Mr Low's appointment," and the second is that "Mr Low is quite unknown in the geological world"

With regard to the first of these statements, I may say that when the Canadian Government—for reasons which it is not my purpose here to discuss—decided that they would not appoint Dr Bell director of the Geological Survey of Canada, they proceeded to select, quite irrespective of all considerations of party politics, the best man who was available in Canada to fill that position They accordingly offered the position in question in succession to two geologists holding chairs in leading Canadian universities Both these gentlemen, however preferred to retain their university connection, and declined the position The Government then decided to promote Mr Low, who was one of the senior field geologists on the Canadian Survey, to the position of director

Mr Low received his geological training at McGill University, taking at the time of his graduation honours in geology He received his geological instruction from Sir William Dawson After graduation he was at once appointed to a position on the Geological Survey of Canada, and was assigned the task of mapping various areas of the pre-Cambrian rocks of the northern portion of the Dominion of Canada The work which he carried out in the region of the great lake Mistassini is well known and he was subsequently sent by Dr G M Dawson to undertake the exploration of that great tract of north-eastern Canada which comprises the Labrador peninsula While others lost their lives in endeavouring to penetrate into the interior of this great unknown land Mr Low traversed it repeatedly from north to south and from east to west, and embodied the results of his work in a series of valuable reports on the geography, geology and mineral resources of this great region, the final report being accompanied by a large four-sheet map of the whole region showing its geological structure along the various lines of traverse We owe to Mr Low practically everything that we know with regard to this great tract of country His observations on the surface features of this region which was one of the chief centres of ice dispersion in the Glacial period, are of great importance in connection with our studies of glacial geology

On the completion of this work in the Labrador peninsula Mr Low spent a year and a half in the investigation of the iron-ore resources of the region about the southern portion of Hudson's Bay and more especially on the islands in the Bay, where great bodies of low-grade iron ore occur

Still later, when the Dominion Government decided to take formal possession of the Hudson Bay region and the islands of the Arctic archipelago they selected Mr Low to take charge of the expedition which they sent to the north for that purpose Mr Low accordingly, in charge of the ship *Neptune*, pushed his way far north through the Arctic archipelago to the Arctic Sea taking formal possession of the various Arctic islands in a cruise which lasted for sixteen months and was accomplished to the satisfaction of the Government in every respect

For these various northern explorations Mr Low received the Gill award from the Royal Geographical Society

The reason that Mr Low's name is not more widely known in Europe is due chiefly to the fact that his contributions to the various geological magazines and transactions have been comparatively few in number the results of his work being published chiefly in reports both voluminous and valuable which were made to the Geological Survey of Canada, and which are to be found in their annual volumes These naturally are read chiefly by those particularly interested in the geology of Canada and consequently do not reach a wide circle of readers

Mr Low also, it may be mentioned is a Fellow of the Geological Society of America, a body composed solely of professional geologists, and one basing its election to fellowship solely on valuable contributions to geological science

The above facts I think, afford an adequate answer to the statement that Mr Low is "quite unknown in the geological world"

In conclusion, it may be safely stated that in appointing Mr Low to the directorship of the Geological Survey of Canada the Dominion Government has secured the services of a gentleman who has not only a sound geological training and an extensive experience in field geology but also a gentleman of initiative and administrative ability in the prime of life and one whose appointment has been well received both by the geologists of the Dominion and by the representatives of the mining interests with which our Geological Survey is so closely identified

FRANK D ADAMS

McGill University, Montreal October 31

NOTES ON ANCIENT BRITISH MONUMENTS

I

The Aberdeen Circles A Letter to Dr Angus Fraser

DEAR DR FRASER,

I told you when leaving Aberdeen that so soon as I had discussed the observations of the stone circles I was enabled to make, thanks to your kindness in placing your motor-car at our disposal, you should be the first to know of the results

Here is my report Before I refer to the observations themselves I will just say why I was so anxious to have a look at your circles During the last year my wife and I had photographed and measured several circles in Cornwall and Devonshire We found outstanding stones, apparently to indicate certain directions in which observations should be made from the centre of each circle I studied the chief directions astronomically, and found that they might have been used to observe the rising places of stars and of the sun at different times of the year in each circle, and that practically the same places of star and sun rising were observed in all the circles This indicated a general use we were dealing with a system, and not with a chapter of accidents Each circle might have been a town clock and farmer's almanac combined, whatever other purpose of utility it may have served

I gave an account of this work in my book "Stonehenge," and very briefly in a letter to *The Times* (July 30, 1906)

Now before I went to Aberdeen Mr A L Lewis, a great authority on these ancient monuments, had told me that your circles were different from those in south England In each of your most perfect circles there is, instead of a *standing* stone outside the circle a *recumbent* stone inserted between two of the stones of which the circle itself is composed Not only had I got this information from Mr Lewis, but I had had the advantage of seeing the many plans prepared for the Gunning fellowship reports by Mr Coles, the assistant keeper of the Museum of Antiquities at Edinburgh

The question, then, was, might the *recumbent* stones in the Aberdeen circles play the same part as the *outstanding* stones in Cornwall and Devonshire? If so, of course they could have been used with the same object, that, namely, of indicating a direction, they would only represent a difference of design, not of purpose

An inspection of some of the available plans suggested that in the recumbent stone and its supporters we had a special form of "cove," the direction required being indicated by a line *across the circle* perpendicular to the length of the recumbent stone

If this were so, we should find the Aberdeen *recumbent* stones placed *at right angles* to the chief direction lines to the *outstanding* stones found in S England, lines used for the star- and sun places I have detailed in my book "Stonehenge," and therefore dealing with practically the same declinations, latitude and heights of hills being taken into account

Now to settle this point it was necessary to obtain trustworthy azimuths of these directions, and of the angular height of the horizon in each direction, and it is here that I owe so much to the kindness of friends in Aberdeen which I am most anxious to acknowledge The University authorities, represented by Prof Macdonald, lent me a theodolite, you placed your motor-car at our disposal, and Dr Milne was good enough to suggest circles to examine, and accompanied us to the sites

The circles examined were Sunhoney, Midmar, Auchquhorties (Fetternear), Raes of Clune, and Old Bourtree Bush

Friday, September 28 —Sunhoney, lat. N 57° 8′, az N 46° E, horizon 4° high These numbers are only approximations, for the recumbent stone is curved, and the horizon is covered by trees Midmar, lat 57° 8′, az N 42° E, horizon 1° 30′ high The alignment was taken on the stone across the circle, its line of direction being, apparently at right angles to the front surface of the recumbent stone The height of horizon is doubtful, in consequence of trees

Saturday September 29 —Auchquhorties (Fetternear), lat N 57° 16′, az N 19° E, horizon 2° 30′ high (assumed half-way up the trees)

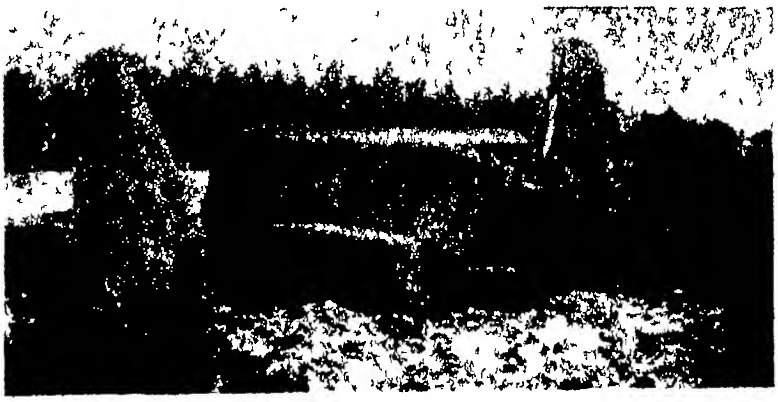


Photo by Mr Ritchie

FIG 1 —The recumbent stone at Auchquhorties showing supporters and other stones directed to the centre of the circle

Monday, October 1 Raes of Clune, lat N 57° 5′ No measures were made, as the ground near the recumbent stone had been excavated, and the stone disturbed Mr Braid, who had taken much trouble to enable us to find the site, and whom we met near it, promised to make a new survey of this and the other adjoining circles for examination at some future time Old Bourtree Bush, lat N 57° 3′, az N 270° W, horizon not measured

Before I discuss these measurements in detail, let me say that the first result which stares one in the face is very remarkable

The measurements of the first five circles, which were selected at random, show that two, like the restored Stonehenge, could watch the sunrise at the summer solstice The direction line of another resembles those of a dozen circles in England, built, as I hold, to watch the rise of the clock-star, and the only other one measured is directed to the sunset at the equinoxes

To enter into details I take the magnetic variation for 1906 at 18° 30′ W; this then has to be applied to the compass bearing to get the *true* azimuth I also give a table of the solstitial azimuths, taking heights of hills into account, for lat 57° —

	True Azimuths Summer	Winter
With sea horizon	N 41 0 E	S 44 46 E
" 1° elevation	43 40	42 10
" 2° "	46 16	39 30
" 3° "	48 20	36 46
" 4° "	50 24	33 56

These values apply in a general way to both Sunhoney and Midmar. The difference of azimuth observed arises from the fact that there is, roughly, a difference of 2° in the angular height of the horizon at the two places. I attach greater weight to the measures at Midmar, as the direction was taken to a stone on the other side of the circle. It may be that this way of making the direction line "siccer" was generally taken; the plans suggest but do not prove it.

Let us, then, look at the Midmar result a little more closely. My rough measures gave an azimuth of N. 42° E. According to the above table the azimuth of the solstitial sunrise to-day, with hills 1° 30′ high, is practically N. 45° E. There is a difference of 3°.

Now in your latitude at the solstice, the sun when it rises or sets grazes the horizon for a long time, the direction of its apparent motion is only slightly inclined to the horizon. To-day it is about 27°. A change in the sun's declination due to the change in the obliquity of the ecliptic, which was greater in past times, will therefore produce a great change in the azimuth of sunrise. Thus to give figures ready to my hand, if instead of the present declination of 23° 27′ we take 23° 50′, the declination at B.C. 1000, according to Stockwell's calculations, the present azimuth of N. 44° 58′ E. (with hills 1° 30′ high) becomes N. 43° 57′ E.

Now this is a degree nearer my value of the azimuth, and if that value is not very much out, and if the recumbent stone was arranged in relation to the solstice, it is clear that the Midmar stones were set up more than 3000 years ago.

To carry this inquiry further, observations much more complete than mine, including observations of the sun with accurate time to get the astronomical bearing directly, are required. We want, too, observations in winter when the leaves are off the trees, so that the height of the horizon can be accurately measured.

To such observations *in your high latitude* I attach very great importance, since changes in direction due to the change of obliquity of the ecliptic can be considered under much more favourable conditions than in S. England in the case of circles connected with the sun at a solstice.

I pass to the azimuth N. 19° E. at Auchquhorties. In S. England, as stated in "Stonehenge," the available clock-stars were Arcturus and Capella. But this was for lat. N. 50°. How about lat. N. 57°? I find that for this latitude these two stars were the only ones available for part of the time, and, further, that Castor might have been used at another time.

In the district round Aberdeen, and especially to the westward, the height of the horizon varies greatly. How this affects the star question, and how it is needful for archæologists to take account of it, will be gathered from the accompanying diagram, which Mr. Rolston has been good enough to prepare.

To show the use to be made of it, let us take the observed azimuth at Auchquhorties, N. 19° E. With hills 2° 30′ high, we find that if a star were really in question, it must at the time of circle-building have had a north declination of 33°. This was Capella's declination about B.C. 1640, and Arcturus's about B.C. 600.

There is a difference of a thousand years, and if further inquiries show that either or both of these stars may have been used in connection with these circles, some progress will surely have been made which it seems cannot be made without it.

It will be clear that when *final* observations have been made at Midmar and other circles which may be connected with a solstice, the sun and star dates may be compared, and each may throw light on the other. For instance, if the final values for Midmar come anywhere near my provisional ones, we shall have an argument in favour of Capella as against Arcturus at Auchquhorties, for it is fair to assume that the circles in any one region, whether solar or stellar, were started at *about* the same time, at least, the evidence furnished by the Cornish monuments is in this direction.

Photo by Lady Lockyer.

FIG. 2.—The recumbent stone and its supporters at Auchquhorties. View from the back looking across the circle.

The result of such detailed inquiries as these will do much to enable us to form an opinion touching the possibility of astronomical considerations having been taken into account by the builders of the monuments.

I wish to plead for the examination of these circles in the widest possible sense. As I have said, they may have served several purposes, some of them at present undreamt of, and in this connection I protest against the logic of those who hold that because graves have been found in them they were constructed wholly for purposes of burial, and that no other considerations were in the minds of those who set up the stones. It is the same thing as to say that because graves are found in our churches the churches themselves were not built for the worship of God.

While I am writing to you I see in the *Scotsman* (November 8) that recent explorations at Fernworthy Circle, on Dartmoor, have shown that every inch of its area is covered with wood charcoal "In fact, fires seem to have been kindled all over the circle, for every scoop of the pick and shovel which was removed from the floor displayed charcoal." Now this looks much more like the result of a succession of Beltaine, or other fires, year after year than of burials, and there would be the closest connection between the orientation of the circle which showed when the time of festival had arrived and the fire which proclaimed its advent

But any way, the more uses were made of the circles the better they are worth investigating

I have no doubt that connected with your magnificent University (and I do not forget that I am now one of you) there is, or soon will be, a strong School of Archæology, happier than most such schools in that you have a fine field of exploration at your doors, for there are 175 stone circles in your shire alone, shown in the Ordnance maps

Now let me keep to my own parish and try to point out that a research touching the application of the orientation theory to these circles would certainly be a source of the greatest interest to the researcher.

First he would have to arrange his observations so that he could discuss the value or the futility of the theory taken as a whole, and then if the theory proved valid he would have to hunt down the use of the May, solstitial or equinoctial year and the stars used as clock-stars The thing bristles with plots for detective stories

What a time the alumnus of this School who has best studied the methods of Sherlock Holmes will have!

First of all, of course, he must visit the ground, that is, the circles, and among the large number he need consider, in the first instance, only those that have well-marked recumbent stones On this point he should consult Mr Ritchie, of Port Elphinstone who has, I believe, photographed them all (and let me say here how grateful I am to him for the gift of several mounted prints one of which, with his permission, I have copied above) Next, let him neglect the names, weights, and colours of the riders—I mean the stones—and simply determine the azimuth of the line at right angles to the recumbent stone taken across the circle, and the height of the horizon in that direction Even the university theodolite is not absolutely necessary, an azimuth compass, and a "clinometer" which can go in the waistcoat pocket, will suffice for a reconnaissance

Now for "clues"

Are the azimuths all helter-skelter, that is, distributed anyhow, among the four quarters of the circle from 0° to 359°? (If so, the culprits need not be sought among astronomers, and the orientation theory is all moonshine)

Is an azimuth, say between N 10° and 25° E, pretty common or quite exceptional? (If pretty common, this will strengthen the view that we are dealing with observations of a clock-star and that blind chance has nothing to do with the inquiry)

Is there any relation between the azimuths and the amount of squaring of the stones? (If so, as the non-squared stones are most probably the oldest, if the azimuths decrease as the squaring gets more pronounced we are dealing with Capella; see diagram)

Is there another group of azimuths between N 40° and 48° E? (If so, as this is the solstitial alignment, it will strengthen the astronomical view.)

Are there any azimuths about N 58° E.? The rising place of the sun at the beginning of May at the Beltaine feast? (If not, we have an argument against great age, as the oldest sun alignments in

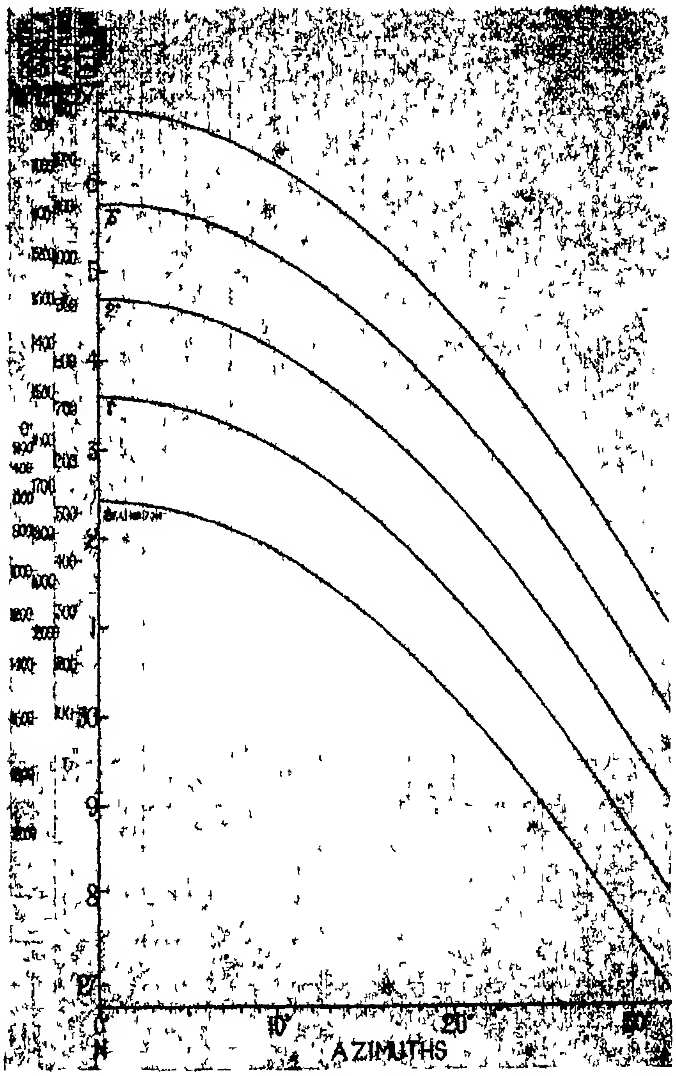


FIG 3—Showing the dates at which the stars Arcturus, Capella and Castor rose at the azimuths indicated, the heights of the horizon being taken into account

Cornwall and along the west coast deal with the May-year)

Is the Aberdeen form found anywhere else? (If so, the other regions in Europe or elsewhere to which it is common may be regarded as in some way connected with the form)

Is it a general rule that the heights of the stones decrease from the recumbent stone to the opposite side of the circle? (If so, the relation of this to the naos at Stonehenge must be considered)

I hope I have succeeded in showing you that there are many points of great interest connected with

your Aberdeen stone monuments which are well worth investigation.

I hope, also, that Aberdonians will see that the necessary work is done. How I wish I could be with you to help in it, and renew the pleasures you allowed my wife and myself to feel, going about among the relics of a long bygone past in your most modern motor car.

Always sincerely yours,
NORMAN LOCKYER

APPLICATIONS OF THE MICROPHONE PRINCIPLE

AN interesting booklet upon applications of the microphone principle has been written by Messrs. Jensen and Sieveking, of the physical laboratories in Hamburg and Karlsruhe.[1] By the term "microphone principle" the authors mean all those phenomena which are due to the change of ohmic resistance between loose contacts. The memoir contains a very exhaustive collection of what is to be found scattered in scientific literature from the time of Munck of Rosenschoeld, to the present day. The explanation that in loose contacts the nearer approach of the particles resulting from the application of pressure is the cause of the diminished resistance observed, is ascribed to du Moncel and Beetz, who gave it almost simultaneously, though independently. Among the early practical applications of this property of loose contacts was Hughes's induction balance, which is so well known that no lengthy reference need be given here. A less known though also interesting application may, however, be mentioned, namely, the demonstration of nodes and antinodes in acoustic waves in cylindrical vessels. By lowering a small microphone into the cylinder, Fossati succeeded in locating the position of the nodes and antinodes by means of a telephone receiver connected with the microphone. The sound waves impinging against the loose contacts produce a rasping sound in the telephone, which vanishes when the microphone reaches the position of a node. In a darkened room minute sparks may be seen between the microphone plates when the microphone is in the position of an antinode.

Another acoustic application of the microphone made quite recently by Hebb is the determination of the velocity of sound. He uses two parabolic mirrors facing each other, and placed on the same axis. The one is fixed, and the other can be moved to a greater or lesser distance. In the focus of the first or fixed mirror is placed a tuning fork and a microphone, in the focus of the movable mirror a second microphone. The secondary of an induction coil having two primary windings is connected to a telephone. The primary windings are connected each with a battery and one of the microphones. The sound waves of the tuning fork act directly on the microphone next to it, and the reflected sound waves on the microphone in the movable mirror. It is easy to see that the loudness of the tone given out by the telephone depends on the frequency of the tuning fork, the distance between the two mirrors, and the velocity of sound. If both microphones receive antinodes at the same time, the tone is loudest, and if there is a phase difference of half a period between them the tone is weakest. Now the phase difference depends on the distance between the mirrors, the length of the acoustic wave, and the frequency. By first carefully determining the latter, and then finding the position of strongest and weakest sound, Hebb was able to determine with great accuracy the velocity of sound. He found it to be 331.29 metres, the probable mean error being only 0.04 m.

The attempts to use the microphone in seismography do not seem to have led to any practical or trustworthy result. Rossi, in 1887, used a microphone consisting of a silver plate and pointed lever in his underground observatory near Rome, and noticed that the telephone gave out sounds which were unmistakably the effect of seismic movements, and when afterwards the apparatus was tranferred to Vesuvius and came under Palmieri's observation, a general agreement between the sounds in the telephone and the records of the seismograph was observed, but the difficulty of separating sounds due to other causes seems to have stood in the way of further developments. Nevertheless, the authors think that the microphone may be made a seismographic instrument of great sensitiveness.

An ingenious application of the microphone for the detection of fire-damp has been made in France by Hardy. If the sound waves of two pipes of equal pitch impinge on microphones connected in series with a telephone a clear note is heard, but if one of the pipes emits a but slightly different note there will be beats heard in the telephone. Now if one pipe is on the bank and the other underground, the latter, if there be fire-damp, will be blown with air of a different density and emit a different note. The telephone, by sounding beats, will then give warning of the presence of fire-damp. The apparatus when tested with coal gas showed great sensitiveness. An admixture of but 0.1 per cent. gave three beats in twenty seconds, and an admixture of 1 per cent. gave thirty beats in twenty seconds.

The memoir deals very fully with the use of the microphone in telephony, including the production of graphic records such as are given by the instruments of Nernst, Lieben, Poulsen, and others. Also the use of the microphone in wireless telephony is touched upon. The most directly useful part of the memoir is, however, a very full account of the work done by a large number of experimenters in order to ascertain the best composition of the material forming the loose contact of the microphone, its mass, area of contact, specific pressure and other determining factors as regards strength and clearness of sound.

The connection between the microphone and wireless telegraphy is not obvious, and the authors deal with this part of their subject very briefly. One sentence is, however, so interesting that it may, in conclusion of this short review be quoted verbatim. The authors say:—"Already in 1879 Hughes has used the influence of spark discharges on microphonic resistances for wireless telegraphy over a distance of 400 meters."

GISBERT KAPP.

[1] Anwendungen des Mikrophonprinzips. By Chr. Jensen and H. Sieveking. (Hamburg: Graefe and Sille.)

SIR EDWARD J. REED, K.C.B., F.R.S.

THE death of Sir Edward James Reed on November 30 brought a long, useful, and highly distinguished career to a close. He was in his seventy-seventh year—full of activity, with mind as vigorous and interests in life and work as keen, as ever. He was an active worker to the end. For the greater part of the last half-century he was the most prominent naval architect of his time. His influence during that long and important period in the progress of naval construction was one of the most potent forces that shaped its development and improvement. That influence was exerted not only by his work and teaching but also by constant and earnest efforts from his earliest days to promote the scientific education and training of young men

for the pursuits of naval architecture and marine engineering, and to raise the scientific standard and professional status of those important branches of engineering

Edward James Reed was born at Sheerness in September, 1830 He received a thorough practical training in the Royal Dockyard there, and was afterwards a student of the School of Mathematics and Naval Construction in Portsmouth Dockyard, where he received the highest education in the science of naval architecture that was obtainable in this country On passing out of the Portsmouth school he was given a subordinate appointment in Sheerness Dockyard, but he resigned this in 1852, and went out into the world to seek his fortune He became editor of the *Mechanics' Magazine* and soon began to play an active part in literary and scientific circles One of his greatest services to the cause of naval science was rendered in connection with the foundation of the Institution of Naval Architects in January, 1860 This would hardly have been practicable, at that time, but for the devotion and ability with which Mr Reed performed the onerous duties of honorary secretary during the period of organisation, and those of secretary for three years after

Mr E J Reed was appointed Chief Constructor of the Navy in July, 1863 This appointment followed upon proposals he had made some time before for improving the design of ironclad ships The earliest ironclads of the *Warrior, Minotaur*, and other classes were found to be imperfect and unsatisfactory, and Mr Reed proposed a radical change of design by limiting the armoured portion of the hull to what was merely sufficient for the proper protection of its vital parts—such as the compartments containing the boilers, machinery and magazines, the gun battery, the rudder head and steering gear, and the waterline area before and abaft the gun battery This became famous as the "belt and battery" system and it is, in principle, the system adopted in the design of battleships and armoured cruisers to-day It enables the thickness of armour to be increased to a maximum upon a given size of ship, and admits of the application of thick armour to ships of smaller dimensions than would otherwise be requisite The wooden ships *Enterprise, Favourite* and *Research* were ordered by the Admiralty to be converted in accordance with Mr Reed's proposals in 1862, and the design of the *Bellerophon* followed immediately after he took office in 1863 The last-named was the first of a continually progressive series of historical ships that led in direct line to the last of our armourclads which fought their guns upon the broadside, while the *Devastation*, the last battleship designed at the Admiralty by Sir Edward Reed, is the first in the series of sea-going battleships, the heaviest guns of which are placed in turrets on deck, which now reaches its latest development in the *Dreadnought* In these typical designs the lines which future progress in battleship design would take are clearly indicated The design of the structure of the hull in the *Bellerophon* was novel and ingenious It has been followed in all subsequent battleships and cruisers for the British Navy, and adopted all over the world An important factor in Mr Reed's success at the Admiralty, which the writer frequently heard him mention, was that he had as his principal assistants Messrs Barnaby (his successor for fifteen years as Chief Constructor of the Navy), Barnes, and Crossland, the best of his old fellow-students at the Portsmouth school He always said that without the aid of men of the highest scientific and technical training, as they were his achievements would have been impossible The value of their

scientific knowledge and ab n naval construction that
new and difficult problems nting themselves for solu-
were then continually preseurnish one of the strongest
tion was so manifest as to fuiralty of the necessity of
proofs to the Board of Admool of naval architecture
maintaining an efficient schof detailed reference to

Space will not admit Admiralty during the
Mr Reed's work at thet evidence of his great
seven years 1863–1870, bund of the scientific value
activity and energy there, an the Transactions of the
of his work, may be found iects for those years He
Institution of Naval Archit 870—as the result of the
left the Admiralty in July, respecting the height of
non-acceptance of his views g ironclads the principal
freeboard requisite for sailin in turrets on deck—and
guns of which were placed t from that time almost
practised as a naval architecAlmost immediately after
to the last day of his life. of his views with regard
he left office the correctness was proved in a tragic
to low-freeboard sailing ship *Captain* He was held
manner by the loss of the e world, and designed
in high repute all over thman, Japanese, Chilian,
famous warships for the Gernts The last of these
and other foreign Governmear name of Sir E J
with which the long-familiae *Libertad* and *Con-*
Reed is connected are thhilian Government by
stitucion, built for the Cms respectively, which
the Elswick and Vickers finavy under the names
now form part of our own ese ships attracted
Triumph and *Swiftsure* Thees because of the high
much attention in naval circlwer they possess upon
speed and great fighting poensions, and they have
comparatively moderate dimvice Sir Edward Reed
proved most successful on serthe Indian Government
was also naval architect for Crown Colonies, and
and the Government of theps of various classes for
designed many successful ship
those Governments

Sir Edward Reed was a strenuous advocate, as we
have said, of scientific and tecchnical education The
School of Naval Construction at Portsmouth, at which
he was educated, was abolished by the Admiralty in
1853, but he joined with other leading members of
the Institution of Naval Architects in 1863 to urge
upon the Admiralty the necessity for establishing
another school for the scientific training of young
naval architects and marine engineers for the
Admiralty service, and also for the mercantile ship-
yards of the country This action resulted in the
foundation of the Royal School of Naval Architecture
and Marine Engineering at South Kensington in
1864 to which most of the leading naval architects
and marine engineers of to-day owe their scientific
training Mr Reed, as Chief Constructor of the
Navy, never failed to promote the interests of this
school He was one of its best and most popular
lecturers, and those who passed through the school
at that time owe to him their first appointments to
responsible posts, in which their qualities could be
tested, and their early professional advancement

In 1873 Sir Edward (then Mr E J) Reed contested un-
successfully the Borough of H a Parliamentary
election He was returned the Pembroke
Boroughs in 1874 and for C in 1880, and sat
continuously in the House of Commons from 1874 to
1895, and from 1900 until last , when he retired
from Parliamentary life He made a C B in
1868 and K C B. in 1880, and ed as member, and
sometimes as chairman, of ny important com-
mittees He was chairman of the Load-line Com-
mittee of 1884 which first made legislation for regu-
lating the depth of loading of ships successful in
practice, and of the Manning of Ships Committee of
1894 He was also the Goverrment Commissioner

who investigated the cause of capsizing of the *Daphne* in the Clyde in 1883. Sir Edward was one of the Lords of the Treasury in Mr. Gladstone's Government of 1886.

Sir Edward Reed was elected F.R.S. in 1876. He sat upon the council of the Institution of Naval Architects from 1863, when he retired from the secretaryship, until his death, and upon the council of the Institution of Civil Engineers from 1883 to 1896. He was the recipient of very high Russian, Austrian, Japanese, and Turkish honours and decorations. Among the works published by him are:—"Shipbuilding in Iron and Steel," 1869, "Our Iron-clad Ships," 1870, "Letters from Russia in 1873," "Japan," 1880, "The Stability of Ships," 1884, "Modern Ships of War" (in collaboration with Admiral Simpson), 1885, "Fort Minster, M.P.," a novel, 1885; "Corona and other Poems," 1857, and "Poems," 1902. He was also the author of numerous papers in the Transactions of the Institution of Naval Architects and other professional institutions, and of two important papers, "On the Relation of Form and Dimensions to Weight and Material in the Construction of Ironclad Ships," which were communicated to the Royal Society by the late Sir George Stokes, and are published in the Philosophical Transactions of 1868 and 1871. He was also the proprietor and editor of the quarterly magazine *Naval Science* from 1872 to 1875, and contributed many articles to its pages.

The subject of this imperfect memoir was not merely a great naval architect, but a man richly endowed by nature with many and varied gifts. He was cheerful and sanguine in disposition, with an attractive and impressive personality, and unusual force and independence of character. He was lucid, graceful, and fluent of speech, and one of the ablest and most effective speakers and controversialists of his time. He long commanded public attention as man of science, politician, orator, and author, and in the last-named capacity he had the unique distinction of earning laurels in fields so far removed from those of his severe professional labours as poetry and romance. No one was more popular or more genuinely admired among his professional brethren and children for his great abilities and accomplishments, and his genial and sociable nature, than the late Sir Edward Reed. FRANCIS ELGAR.

NOTES

A REUTER message from Stockholm states that the formal distribution of the Nobel prizes took place on Monday evening. Prof. Moissan, Prof. Thomson, Prof. Golgi, and Prof. Ramon y Cajal each received the prize diploma and a gold medal from the King of Sweden in person. Each prize this year amounts to 7659*l.* Prof. Thomson's prize is awarded to him for his researches extending over many years into the nature of electricity, and Prof. Moissan's for his experiments in the isolation of fluorine, his researches regarding the nature of that element, and for the application of the electric furnace to the service of science. Profs. Ramon y Cajal and Golgi are bracketed for the medicine prize on account of their works dealing with the anatomy of the nervous system.

THE Government geologist of South Australia reports that the discovery of corundum in the Farina district is likely to be one of considerable value. The corundum occurs in metamorphic schist, the proportion in the rock amounting in places to 10 per cent. to 25 per cent.

THE American mail brings the announcement of the death, on November 23, of Dr. William H. Chandler, emeritus professor of chemistry at Lehigh University, at the age of sixty-five years. Dr. Chandler taught for many years in the Columbia School of Mines, and was the author of several important works.

IN an article in the *Pall Mall Gazette* (December 10) with the somewhat sensational title of "The Approaching Conquest of Cancer," Dr. Saleeby states that several cases of cancer have been cured or much improved by injections of trypsin, one of the pancreatic ferments, a method of treatment suggested by Dr. Beard, of Edinburgh. Even if this be correct, however, it by no means follows that cancer is to be conquered in the near future, and the premature publication of such details as these in the public Press serves no useful purpose.

MR. W. R. BUTTENSHAW, who has been scientific assistant on the staff of the Imperial Department of Agriculture for the West Indies during the last four years, has been offered the post of botanist in the Agricultural Department of India. He will vacate his present post as soon as his successor has been appointed.

THE annual conversazione and exhibition of new apparatus arranged by the British Electrotherapeutic Society will be held in the small Queen's Hall on Friday, December 14, from 7.30 p.m. to 10.30 p.m. The exhibition will be open from mid-day.

WE learn from the *Chemist and Druggist* that a wealthy landed proprietor named M. Audrac, who died recently at Le Luc, near Draguignan, has left the Pasteur Institute the whole of his fortune, valued at the equivalent of 50,000*l.* at least. Interviewed on the subject, Dr. Roux, the distinguished director of the institute, stated that he had received a visit from a lawyer, who informed him that a will had been found bequeathing the whole of the property to the institute. The reserve, however, was made that another document might possibly come to light making various bequests or otherwise disposing of part or whole of the property; consequently Dr. Roux says that some time must elapse before the Pasteur Institute can know definitely how it stands with regard to the inheritance.

BY the death of Mr. John Ward, of Longton, Staffs, British geology has lost one of those quiet, earnest workers who, in the midst of their other duties, achieve so much for science. Mr. Ward was an original member of the North Staffordshire Field Club, and one of the most regular and valued contributors to its Transactions. In 1874 he was elected a Fellow of the Geological Society of London, and in 1898 he was the recipient of an award for his work upon the fossil fauna and flora of the North Staffordshire Coalfield. As a collector, Mr. Ward was the happy possessor of a splendid enthusiasm tempered with sound knowledge; a large part of his collection of Coal-measure fishes is now in the British Museum (Natural History). While attending to the conduct of his business and devoting his spare time to geology, Mr. Ward yet found it possible to take a prominent part in the duties of citizenship. He will be missed greatly by students of Carboniferous faunas, not in this country alone, but by his numerous friends abroad.

THE following telegram, dated Bombay, November 20, has appeared in the public Press:—"Dr. von Lecoq, a scientific emissary of the Prussian Government, has arrived safely at Srinagar after a journey through the most remote parts of Central Asia. He has brought with him a quantity of highly interesting paintings on stucco, the backgrounds in many cases being of gold leaf as in Italian

work, and a number of manuscripts in ten different languages and one wholly unknown tongue. Dr. Lecoq's discoveries probably constitute the greatest archæological find since the days of Layard and Rawlinson." Dr. von Lecoq will probably not be over-pleased with the last sentence of this telegram, for the wording of which he of course is not responsible. He had been sent to explore sites in Chinese Turkestan like those discovered by Dr. Stein some years ago; Dr. Stein published his discoveries in his well-known book "Sand-buried Cities of Khotan" (reviewed in NATURE of July 21, 1904, vol. lxx., p. 275). Dr. von Lecoq has evidently trodden successfully in Dr. Stein's footsteps, and has, judging by the description in this telegram, found antiquities of the same type as those brought back by the earlier explorer, and now exhibited in the British Museum. To compare with the epoch-making discoveries of Rawlinson and Layard the work even of the pioneer of the archæology of Turkestan, Dr. Stein, would show great want of a sense of proportion. Such comparisons are always odious, and often, as in this particular instance, simply silly.

THE eighteenth annual dinner of the Institution of Electrical Engineers was held on December 4. The president, Dr. R. T. Glazebrook, F.R.S., presided over a distinguished company. Mr. H. Babington Smith, who proposed the toast of "The Institution of Electrical Engineers," pointed out the good which has been done by the visit of foreign friends in the summer, one of the results of which was the establishment of the International Commission for the Standardisation of Electrical Nomenclature and the Rating of Electrical Machinery under the auspices of the Institution of Electrical Engineers. The recent growth of wireless telegraphy was then compared with that of what might be called ordinary telegraphy. In 1825 a telegraph line was laid for a distance of about eight miles, and this might be regarded as the starting point of ordinary telegraphy. Little advance was made during the next ten years, and it was more than forty years before telegraphy across the Atlantic became practicable. Wireless telegraphy, on the other hand, was put into practical application in less than ten years from its beginnings, and the crossing of the Atlantic will probably be satisfactorily accomplished in less than forty years. The president, in replying, referred to the tablet recently unveiled by Lord Kelvin in memory of Michael Faraday in the building (formerly a chapel in which Faraday worshipped) of the National Telephone Company at Barnsbury, London, N. It is seventy-five years since Faraday first published a description of his original magneto-electric machine. Progress has indeed been great since then, especially during the last few years. The basis upon which the subject rests has been firmly established by Faraday's disciples, Kelvin, Maxwell, and others, and the progress has been great because the efforts of scientific and practical men have been combined in due proportions. Lord Justice Buckley proposed "Science and Industries." Sir Arthur Rucker, in responding, said that science and industry are mutually supplementary. The general view, no doubt, is that industry follows rather from science, and the corresponding view is that science follows from industry. There is an element of truth in both views. Very frequently, indeed, great scientific discoveries follow from the efforts of those who are interested in industry. The two things are best closely combined.

IN No. 1496 of the Proceedings of the U.S. National Museum (vol. xxxi., pp. 569–591) Mr. M. Ward Lyon points out that the great anteater inhabiting Central America, for which he proposes the name *Myrmecophaga centralis*, is readily distinguishable from the typical *M. tridactyla* (or *jubata*) of Brazil by skull-characters. As shown in the plate accompanying his paper, the most distinctive difference between the skulls of the two forms is to be found in the degree to which the frontals interpenetrate the nasals, the dissimilarity in this respect being very great. It was only to be expected that detailed examination would reveal local differences in a type ranging from Guatemala to Brazil.

No. 1495 (vol. xxxi., pp. 539–568) of the Proceedings of the U.S. National Museum is devoted to a detailed description, by Mr. A. Hrdlička, of a collection of twenty-six skulls of the orang-utan obtained by Dr. Abbott in western Borneo, twenty-four of these coming from the Sakaiam River district in Landak. Some difficulty was experienced in determining which specimens belonged to fully adult animals, the dentition affording no trustworthy evidence. The best test, in the case of males, appears to be the fusion of the temporal ridges to form a sagittal crest. After recording measurements of a number of the specimens, the author refers to various dental abnormalities, such as the presence of supernumerary cheek-teeth and the diminution in the size of the hinder molars in some female specimens.

Two papers in the *American Anthropologist* (vol. viii., No. 2, April–June), the one by Dr. J. C. Merriam and the other by Prof. F. W. Putnam (to whom we are indebted for separate copies of both), deal with recent cave-exploration in California, and the evidence thereby afforded in favour of the existence of Pleistocene man in that State. The mammalian fauna of Mercer's, Potter Creek, and Samwel Caves (which appear to be the most important of the group) has been described in various papers by Messrs. E. L. Furlong and W. J. Sinclair, who have recorded remains of the ground-sloth Megalonyx and of two remarkable new genera of ruminants, Preptoceras and Euceratherium, which seem to show evidence of affinity both with the musk-ox and with the Himalayan and Tibetan takin (Budorcas). In some of these caves it appears to have been the custom of the natives to throw in the bodies of their deceased relatives, and the bones remaining from these appear to be younger than those of the ground-sloth fauna. The most important evidence of the coexistence of man with the latter is afforded by certain polished and pointed bones, a small percentage of which are perforated. Many of these bones recall those found in the shell-mounds, although they are less rough, and some may be portions of Euceratherium skeletons. Stone-payments showing unmistakable evidence of man's handiwork occur in the caves, and in Prof. Putnam's opinion these are probably of Pleistocene age. According to the same authority, two perforated bones figured in his paper "are sufficiently important to warrant the belief that man inhabited the vicinity of the caves at least as early as the latter part of the Quaternary period."

PROF. KELLOGG, of the Stanford University, gives in *Science* of November 23 a short account of a preliminary investigation conducted by Miss L. Ramsay under his direction as to assortative mating, in nature, between individuals of different varieties of the lady-bird *Hippodamia convergens*. The investigation was interrupted by the great earthquake, but from sixty cases noted it is concluded that the matings are "wholly non-selective, they are chance matings." This conclusion is not, however, quite in accordance with the numbers given in the text,

which, so far as they go, indicate a certain degree of homogamy, and it is to be hoped that the investigation will be taken up again next year with the view of obtaining sufficient observations to warrant a more confident conclusion

A PRELIMINARY notice of the Ramie Growing Association, formed with the object of fostering the industry in this fibre, has been received from the honorary secretary, Mr D Edwards-Radclyffe

THE list of seeds of hardy herbaceous plants and of trees and shrubs available from Kew for exchange with botanic gardens has been published as the first appendix to the *Kew Bulletin* for 1907

IN view of the fact that there is an import trade of sugar into India exceeding a quarter of a million of tons per annum, it is difficult to realise that nearly one-fifth of the world's output of sugar is produced in the Indian Empire chiefly from the sugar-cane and also from certain palms In the course of an article on the subject in *Tropical Life* (November) the annual production in India is roughly computed at three million tons, and if more efficient methods of extraction were adopted this amount could be largely increased Among various references to rubber in the journal, a note on block rubber indicates the advantages attending this method of preparation over the previously belauded biscuit, and an article on Ceara rubber refers to the hopeful expectations of establishing the tree in various parts of southern India A short account of Mr W Fawcett's efficient work in Jamaica accompanies his photograph that is presented in this number

A FLORA of the State of Washington, prepared by Mr C V Piper, forms vol xi of the Contributions from the United States National Herbarium Partly owing to the seaboard position of the State, the flora presents numerous ecological features of interest that are described at some length and lavishly illustrated Six important zones are distinguished, the upper Sonoran area coextensive with the sagebrush, *Artemisia tridentata*, the humid transition where the red fir, *Pseudotsuga mucronata*, is dominant the arid transition area characterised by prairies of *Agropyron spicatum* or forests of *Pinus ponderosa*, a Canadian zone where *Pinus monticola* grows, a Hudsonian or zone of *Abies lasiocarpa*, and an Alpine region The systematic enumeration shows a preponderance of Compositæ, in which order Senecio is an important genus, among other large orders, Castilleja, belonging to the Scrophulariaceæ, Lupinus and Phaca, to the Leguminosæ, are characterised by a considerable proportion of endemic species

THE current issue of the Records of the Geological Survey of India (vol xxxiv, part ii) contains the statistics of the mineral production of India during 1905, by Mr T D La Touche The total value is given as 5,707,956*l*, which is 350,116*l* in excess of that for 1904 Nearly every item shows an increase Gold, with a value of 2,416,966*l* takes the first place, and coal, with a value of 1,436,951*l*, the second The output of coal, 8,417,739 tons, has again exceeded all previous records Other minerals for which returns of production are given are, in order of importance, petroleum, salt, saltpetre, manganese ore, mica, rubies, jadestone, graphite, iron ore, tin ore, chromite, diamonds, magnesite, and amber Incomplete returns are given for alum, arsenic ore bauxite, borax, building stone, clay, copper ore, cornelian, corundum, garnet, gypsum, limestone, marble, slate, steatite, and tourmaline In the same issue Mr F Vredenburg gives a detailed account of *Nummulites Douvillei*, an undescribed species from Kachh, named in honour of the geologist whose researches on the Foraminifera have thrown so much light on the classification of the Tertiary system The paper concludes with a summary of the zonal distribution of Indian Nummulites Mr J Malcolm Maclaren gives a detailed description of some auriferous tracts in southern India, in territory under British administration or within the Nizam's dominions The paper is accompanied by a coloured geological map of the Gadag auriferous belt, Dharwar district In this goldfield the extensive old workings are of great interest Numerous small vertical shafts, 4 feet square, were sunk by the ancient workers to the dip of the veins, often not cutting the vein until the shafts were 80 feet in depth The veins were then followed on the underlie with great assiduity to a depth of at least 300 feet Abundant relics of mills for crushing quartz exist Those of most frequent occurrence were essentially rock breakers, in which the quartz was broken to the size of a walnut They are depressions 6 inches wide and 4 inches deep in hard rock Into these mortars there fitted rude stone pestles 9 inches long, and sufficiently thick to be grasped in the hand The Gadag goldfield is exceptionally well situated for economic working, and is of special geological interest in the occurrence of its gold-quartz veins in argillites In the last paper Mr R R Simpson records the abandonment of the collieries worked by the Government of India at Warora, Central Provinces, in consequence of a serious subsidence that took place on March 28

Photo J M Maclaren

Ancient Rock Mortars, with Pestles, near Sangli Mines, Gadag

FATHER GUTIÉRREZ LANZA S J, assistant director of the Belén Observatory, Havana writes taking exception to the statement in these Notes, in NATURE of October 25 (vol lxxiv, p 642), that the great hurricane of October 17 had burst over Cuba "apparently with little or no warning" The note was based on the cabled reports which stated that Father Laurent Gangoiti had telephoned to Columbia Camp an hour before the storm burst announcing its

approach From the information now supplied by Father Gutiérrez-Lanza, it is clear that both in the local newspapers and in messages to the U S Weather Bureau at Washington, Father Gangoiti had on October 12 announced the existence of a cyclonic disturbance south of Barbados, on October 16 that it was about 500 miles south of Havana at 6 a m October 17, that it was approaching western Cuba and moving towards Florida, and at 3 p m of the same day that the cyclone was nearing Havana province The storm reached the city of Havana at 10 p m The word "apparently" in the note was intended to cover any possible imperfections in the hurried early reports of the calamity With the information bearing upon the predictions of the approach of the recent hurricane towards Havana, Father Gutiérrez-Lanza has forwarded an interesting brochure on "The Pioneer Forecasters of Hurricanes" by the Rev Walter M Drum, S J, of Georgetown University

IN *Engineering* (vol lxxxii, No 2135, December 1) Mr H Burcharts gives illustrations of the sand-blast apparatus used for testing building materials at Gross-Lichterfelde Institute Some results of tests are given showing that the new method gives useful information with regard to the power of resistance to wear in practical use, and to the quality of road and floor materials The duration of the exposure to the sand blast has, after many experiments, been fixed at two minutes, the steam-gauge indicating a pressure of two atmospheres This short time suffices to give a good indication of the structure of the materials tested and their resisting qualities The sand used is a natural quartz sand of fine and nearly round grains, procured by washing and drying the original sand and passing it through a sieve with 120 meshes per square centimetre, or about 774 meshes per square inch It is the waste from the German standard sand used for testing Portland cement the grains of which pass the sieve of sixty meshes, and are retained on the sieve with 120 meshes per square inch Granite from Malmo lost 0 09 cub cm per square cm, blast-furnace slag Bochum, 0 12 red pine 0 10, and linoleum 0 02.

SIGNOR GUIDO BORDONI-UFFREDUZZI gives a summary of sanitary progress in Milan, accompanied by diagrams of statistics of death-rates, particularly from infectious diseases, during the past thirty years The paper is published in the Lombardy *Rendiconti*, xxxix, 14

PROF TEMISTOCLE CALZECCHI-ONESTI, writing in the *Rendiconti* of the Lombardy Institution, xxxix, 14, regarding the discovery of the coherer, directs attention to his experiments made in 1884, before Branly had worked on the subject He further points out the important part played by Righi in the discovery of wireless telegraphy

IN the *American Journal of Mathematics*, xxviii, 3, Mr F J B Cordeira discusses the analogy between gyroscopes and cyclones The author considers that the oscillations of a gyroscope have a close analogy in the motions of cyclones about a position of equilibrium It is also suggested that the frictional couple due to cyclones tends to accelerate the earth's rotation, and that the effect is cumulative, though it should be noticed that the only possible result is the transference of angular momentum between the atmosphere and earth, and that the total angular momentum of both cannot be altered

IN the Proceedings of the Royal Philosophical Society of Glasgow, under the title "Solution of Physical Problems," Prof Andrew Gray, F R S, discusses two problems in the theory of attractions The first is the determination of the attractive force between the two halves of a sphere of gravitating matter, the surfaces of equal density being concentric spheres The problem for the case of uniform density was solved by Prof Tait in a very simple way by considering the hydrostatic pressure on the supposition that the sphere was fluid In the present paper three methods are considered, namely, the hydrostatic method, a method based on Gauss's well-known theorem of the flux of force over a closed surface, and a third based on a simple theorem according to which the attraction between two concentric hemispherical shells is the same as if the mass of the inner shell were concentrated at the centre The second part of the paper consists in a re discussion of the problem of the attractions of ellipsoids, with some historical notes and alternative methods of treatment.

THE number of the Journal of the Chemical Society published on November 29 contains abstracts of several mineralogical papers One of these (F Zambonini) describes crystals of galena deposited by sublimation on the scoria at the edge of the crater formed as a result of the eruption of Vesuvius in April This galena appears to owe its origin to the action of hydrogen chloride on the vapours of lead chloride An abstract (F Hussak) describes the bean-shaped pebbles considered to be a good indication of the presence of diamonds, in the alluvial gravels at Diamantina, Brazil They include two new mineral species and consist of barium aluminium phosphate, named gorceixite strontium aluminium sulphato-phosphate, named harttite, and lead aluminium phosphate, probably identical with plumbogummite An abstract of a paper by Mr A Pauly describes a new mineral of the zeolite group from Hainburg, Lower Austria, and another (G d'Achiardi) deals with a similar mineral from Elba

MESSRS W HEFFER AND SONS, Cambridge, have purchased the mathematical library of the late Prof Joly, of Dublin, and the botanical library of the late Prof Marshall Ward, of Cambridge Catalogues of the libraries are in preparation

WE have received a copy of an important contribution to the *American Anthropologist* (vol viii, No 3, July–September), which has been published separately The paper, which was presented by the American Anthropological Association to the International Congress of Americanists held at Quebec this year, deals with recent progress in American anthropology, and is a review of the activities of institutions and individuals from 1902 to 1906

EVERY attempt to increase the number of people with an intelligent interest in science deserves encouragement Our contemporary *Knowledge and Illustrated Scientific News* continues its efforts in this direction, and presents its readers month by month with accurate and interesting accounts of modern scientific work prepared by writers in close touch with knowledge in the making In addition to illustrated articles, each issue of the magazine includes sections in which the progress made in the various branches of science is noted in correct though popular and easily understood language

THE issue of "Who's Who" for 1907 is even more complete than the edition of a year ago Its size has been increased by nearly a hundred pages, and there are now 1058 pages of short autobiographies of persons of import-

ance in the world of work and the world of society Prominence is given to men of science who have added to knowledge, and many foreign investigators are recognised equally with those of our own country There is however a striking disparity in the amount of detail provided in the various life-histories while in the case of some American scientific workers details are provided of each step in their careers and of their individual papers many Fellows of the Royal Society supply the reader with next to nothing about themselves, but as a whole "Who's Who" is an indispensable work of reference, and the editor is to be congratulated upon its completeness The tables which were formerly included with the biographies and were in fact the nucleus of the book are published separately in an extended form under the title "Who's Who Year book, 1907"

OUR ASTRONOMICAL COLUMN

COMET 1906*g* (THIELE) — A new set of elements and an ephemeris for this comet computed by Dr F Stromgren appear in No 4138 of the *Astronomische Nachrichten* The following is an extract from the ephemeris —

Ephemeris 12h M T Berlin

1906	α (true) h m	δ (true)	1906	α (true) h m	δ (true)
Dec 14	12 59	+53 6 4	Dec 26	14 35	+58 24 6
18	13 32	+55 29 2	30	15 2	+59 13 3
22	14 5	+57 12 7			

On the last named date the brightness of the comet will be about half that at the time of discovery (mag = 8 5)

The results of a number of observations of this object appear in No 4137 of the same journal

COMET 1906*h* (METCALF) —Numerous observations of this comet are recorded in No 4138 of the *Astronomische Nachrichten* and an ephemeris and set of elements calculated by Herr M Ebell are also given

Observing this object with the large equatorial of the Bordeaux Observatory on November 22 M E Esclangon perceived two nebulosities near to his comparison star B D 3° 696 These objects were easily visible and differed in shape the first being elongated, with a length of about 30″ and the second being circular with a diameter of about 20″ Taking α and δ as the equatorial coordinates of the star B D 3° 696 the coordinates of the respective centres of the nebulosities at 11h 30m (M T Bordeaux) on November 22 were

α − 6 4s δ + 6″ and α 5 3s δ 2 20″

but the various settings on the second object appeared to show an hourly movement of α = + 0 7s δ = 7″ On November 23 M Esclangon was unable to re discover these nebulosities

On receiving the news of this observation it occurred to Prof Kreutz that the nebulosities might be companions to comet 1906*h* and he therefore asked for observations of B D − 3° 696 from several other observatories Prof Millosevich replied that he could find no appendices to this star which was however unfavourably placed for observation whilst at the time of publication no other observers had been able to make the desired observations

A METEORITE IN THE ATLANTIC (OCTOBER 17) —The owners of the Prince line of steamers have received a letter published in the *Liverpool Journal of Commerce* (November 27) from Mr C B Anderson captain of the *African Prince* describing the fall of a meteorite observed by him on October 17 Captain Anderson says in the course of his letter —"On the evening of October 17 I was on the bridge with the second officer when suddenly the dark night was as light as day and an immense meteor shot comparatively slowly at first because the direction was so very perpendicular to our position then more rapidly towards the earth Its train of light was an immense broad electric-coloured band gradually turning to orange and then to the colour of molten metal When the meteor came into the denser atmosphere close to the earth it appeared, as nearly as it is possible to describe it like a molten mass of metal being poured out It entered the water with a hissing noise close to the ship"

SOME REMARKABLE SMALL NEBULÆ —In No 4136 of the *Astronomische Nachrichten* Prof Barnard describes and gives diagrams of, several remarkable groups of small nebulæ which he has discovered since 1888

In the first group there are six nebulæ two of which were probably originally discovered by Stephan in a circular field of 16′ diameter The second group also contains six two of which are remarkably small and are elongated and several other nebulæ were suspected in the same field From the frequency with which these groups occur associated in isolated compact clusters Prof Barnard thinks there can be no doubt but that the members of each group are physically connected Both the above groups and two others found in 1889 and 1890 respectively were discovered with the 12 inch refractor of the Lick Observatory

Another nebula which from its remarkable shape Prof Barnard has named the "Bug Nebula" was discovered by him with a 5 inch refractor in 1880 This object as seen in the 36 inch refractor is a triple nebula having streamers running in a north preceding direction from the two preceding components and two nebulous arches springing from the following component thus giving the whole the appearance of a ghostly beetle of some kind In the N G C it is designated by the number 6302

THE PERIOD OF β CEPHEI —Finding that the observations of the interesting spectroscopic binary β Cephei made during 1901 and 1902 were insufficient to fix the period with certainty although they showed that in all probability it was exceptionally short Prof Frost made arrangements to obtain several spectrograms on each observing night during the past summer and now publishes a preliminary account of the results in No 4 vol xxiv of the *Astrophysical Journal*

As many as twenty two prism plates with an average exposure of twenty minutes were secured in one night and the preliminary discussion of the total shows that the period of the star's radial velocity is probably very near to 4h 34m 11s The provisional measures also indicate a range of velocity of about 34 km from about + 12 km to − 22 km

Some speculations as to the radius of the orbital motion of the bright component and the inclination of the orbit to the line of sight suggest that the bright body must be near to the centre of gravity of the system and they also raise the question as to whether the two components must not be nearly in contact Indications of the second component spectrum suggest that the difference between the magnitudes of the two bodies may be small

If these preliminary measures are confirmed the period of β Cephei is by far the shortest yet discovered for a spectroscopic binary star

NEW VARIABLE STARS By the method of superimposing a negative upon a positive of the same region taken on a different date Miss Leavitt has discovered twenty eight new variable stars in the region of the Southern Cross and the Coal sack Two these were discovered on a plate having the Orion nebula at its centre and one on a plate having the Pleiades central Prof Pickering remarks on the paucity of variable stars in the vicinity of the Pleiades and states that the conditions in that region seem to favour unusual constancy in light The position and the range of variability of each of these thirty-one variables are given in Circular No of the Harvard College Observatory

OBSERVATIONS OF PHŒBE IN 1906 From Circular No 119 of the Harvard College Observatory we learn that nine additional photographs of Saturn showing images of Phœbe were obtained with the 24 inch Bruce telescope at Arequipa during August and September The photographs have been measured and the resulting positions of the satellite in respect to Saturn are given in the Circular

AMERICAN GOOSEBERRY MILDEW

MR. E. S. Salmon, the mycologist to the South-Eastern Agricultural College at Wye, Kent, is the active leader of an agitation against a mildew affecting gooseberries known as *Sphaerotheca mors uvae*. The fungus in question is of American extraction, and somehow it was introduced into Ireland about the year 1900, it has since spread, has already effected much mischief, and will undoubtedly cause more.

In Sweden it has, we believe, been very destructive, and quite recently its presence has been detected in England. Curiously enough, its introduction into Britain has been associated with the yellow-flowering currant *Ribes aureum*. This is a Californian shrub that has long been cultivated for ornamental purposes in this country, and, up to this time, we have not heard of its being subject to the attacks of mildew.

It now appears that Continental growers of gooseberries make use of *Ribes aureum* as a "stock" whereon to graft the common gooseberry. Standard gooseberries are by no means in general cultivation in this country, and we are informed that the use of *Ribes aureum* is being discontinued owing to the circumstance that it produces objectionable suckers. We do not know what object cultivators had in using *Ribes aureum* as a stock, and indeed we were not aware that it was so used until recently, but from the circumstance already mentioned that the golden flowered currant has long been cultivated here without detriment to neighbouring gooseberry bushes, we may acquit it of anything but indirect participation in the spread of the mildew.

Still in whatever way the pest may have been introduced we cannot but look upon it as a serious matter. The trade in ripe gooseberries is no doubt relatively of little importance, but the prices obtained in the market for "green gooseberries" early in the season are often very high, and the market gardener who was deprived of this source of income would suffer seriously. In face of these facts it is recommended that the importation of all gooseberry bushes, especially of those "worked on" *Ribes aureum* be prohibited and that all bushes known to be affected should forthwith be destroyed by fire.

It is evident that such measures could never be efficiently carried out by individuals. If one grower in any district proved negligent, all the careful ones would suffer from his default. No system of Government inspection would be sufficient to keep out the intruder. Not the keenest mycologist in the world could guarantee that no fungus spores were introduced even if the importation of gooseberry bushes were prohibited. Not the most experienced microscopist could guarantee that all the fungus spores in a particular plantation were destroyed by the cremation of the affected bushes. The spread of the Phylloxera throughout the vine growing countries, despite the most elaborate precautions, shows how ineffective those precautions were. At the same time they caused much inconvenience and loss to the traders and others—a loss which was all the more serious, as, except in the case of vines, it was wholly unnecessary.

It is to be hoped that if legislation on the lines proposed by Mr. Salmon be carried out it will be administered with due discretion, otherwise the remedy may prove more injurious to the interests of the cultivator than the mildew itself. In the meantime the Board of Agriculture has issued a circular giving a description of the fungus and of its mode of life directing the attention of growers to the imminence of the danger, and recommending that every precaution be taken in the purchase of the bushes, especially those from Ireland and the Continent, that all affected shrubs be forthwith burnt, and that as a measure of precaution spraying with Bordeaux mixture be carried out during the winter in the case of plants in any way open to suspicion. The Board states that there is at present no law dealing with the eradication of the pests of fruit trees, and that it depends very largely on the action of the dealers and of the growers whether or not the further development of the pest can be prevented.

*Since writing the foregoing remarks we notice in the *Times* of December 8 that Mr. Massee has, at the request of the Board of Agriculture, visited the neighbourhood of Evesham, where he was told that the disease had existed for thirty years, "and had not affected the fruit," so that there is absolutely "no necessity for panic." Panic and discretion are at opposite poles. If we might offer advice to the gooseberry growers it would be that they should practise watchfulness and act with discretion.

RECENT PROGRESS IN MAGNETO-OPTICS.[1]

Rotation of the Plane of Polarisation close to an Absorption Band.[2]

FARADAY'S rotation of the plane of polarisation is extremely small in all gases, also in sodium vapour. Only within a very narrow range close to the sodium lines the rotation is positive and very great, a fact discovered by Macaluso and Corbino.[3] In a recent extremely interesting paper Prof. Wood has given measurements of observed rotation of four complete revolutions.[4] This, however, was in rather dense vapour, at least dense in comparison with the vapour used in the experiments now to be described, in which vapour containing about one-millionth gram of sodium per c.m.[3] was used.

The magnitude of the rotation close to the sodium lines is illustrated by measurements made by Dr. Hallo in the Amsterdam laboratory. It is clear that on both sides of an absorption line the rotation is in the same direction. We may attenuate the vapour still further so that the doublet in the direction of the lines of force becomes visible. What is the rotation, then, between the components of the doublet?

It is easily deduced from Prof. Voigt's theory that in very diluted vapours the rotation must occur, in a sense, opposite to that outside the components, and therefore negatively, and also that it must be very great. In the case of sodium vapour I had the pleasure to confirm this theoretical result, and to observe rotations of $-400°$.

In these experiments interference fringes in the spectrum were used, established by means of a system of Fresnel quartz wedges (a method used by Voigt, Corbino, and others in similar cases). I will project these fringes on the screen.

If a plate of quartz, which rotates the plane of polarisation, is held in the ray, you will notice a displacement of the fringes. A plate of glass has no influence, of course. I have here a quartz plate which rotates the plane of polarisation through 90°, and you will notice a displacement of half the distance between two fringes. A displacement of the entire distance between two fringes corresponds to a rotation of half a revolution.

Analysing the light by means of a Rowland grating we can produce such a system of fringes for all wave-lengths and can consider the rotation for wave-lengths close to the controlling absorption bands. On the screen I will first project the fringes close to the sodium lines with the field off. The dark vertical lines are the sodium lines. They are broad because the vapour is rather dense. The horizontal bands are the interference fringes. With the magnetic field on, the image now projected is seen.

You see how fast the rotation increases in the vicinity of the absorption lines, becoming more than 180° closer to the bands. In the interior of the bands only a hazy fringe is seen. A remarkable equation, first deduced by Becquerel[5] gives the law of the rotation. The phenomenon is more beautiful as soon as the vapour is so thin that the doublet is seen (Fig. 5).

Outside the components of the doublet the fringe rises *upwards*, but inside the components the fringe has moved *downwards*, the rotation is negative there. The rotation is $-90°$ for D_1, nearly $-180°$ for D_2. It is very interesting to watch the movement of the fringes in the spectroscope as the field is increased or the density of the vapour changed.

[1] Discourse delivered at the Royal Institution on Friday, March 30, by Prof. P. Zeeman. Continued from p. 140.
[2] Zeeman, Proc. Ac. Sciences, Amsterdam, May 1902. Hallo, Thesis Amsterdam 1902. Archiv Néerl. ser. 2, T. 10, p. 148, 1905.
[3] Macaluso and Corbino, *Comptes rendus*, cxxvii., p. 548, 1898.
[4] Wood, *Phil. Mag.*, October 1905.
[5] Becquerel, *C. R.*, cxxv., p. 679, 1897. *Cf.* also Schuster, "The Theory of Optics," pp. 291–294, 1904. Siertsema, Proc. Ak. Amsterdam, xii., p. 499, 1903.

Double Refraction and Resolution of the Absorption Lines

In the second place, we will now consider the *double refraction* which occurs whenever light traverses a vapour at right angles to the magnetic field. A plane wave with vibrations parallel to the field has a velocity different from that of a wave with vibrations at right angles to the field. It is only close to the absorption band that the difference becomes perceptible. Sodium vapour in a magnetic field behaves as a double refracting crystal for light close to the sodium lines. This result of Voigt's theory was verified by him in conjunction with Wiechert in the case of dense vapours, and commented upon by Becquerel and Cotton.

With great density, and using the same system of interference bands, the phenomenon assumes the appearance now projected. Whereas the rotation of the plane of polarisation was symmetrical on both sides of the absorption band, you see that the double refraction is not. On one side of the absorption line sodium vapour behaves like a positive crystal, on the other side like a negative one. With very dilute sodium vapour, and with a magnetic field strong enough to resolve the sodium lines, the theory must be extended. There is no difficulty here. The observations made by Mr. Geest, as well as by myself, concerning the details of this double refraction, have fully confirmed Voigt's theory.[1]

The slides shown always refer to *one* of the yellow sodium lines, and hence the structure seen is almost entirely confined to the extremely small region between the components of one line. The line D_2 splits up into three components in a moderate field. The theoretical course of double refraction is given in a diagram, next to it the result of observations is given (Figs. 6 and 7). On a somewhat larger scale the appearance is as now shown. With greater density the characteristic sinuous line undergoes transformation. The line D_1 splits up into a quartet. Besides the concave parts, you will now notice a line with a point of inflexion in the theoretical and in the observed curves.

The same phenomenon is again illustrated by the next slide, where also the change which occurs with greater density is manifest. In a very strong field the line D_2 is resolved into a sextet. The inverse sextet can be readily seen with the means at our disposal, but the phenomena occurring between these narrow-spaced components could only be seen with difficulty. Only in very favourable circumstances Mr. Geest observed the image now projected.

All the described phenomena are qualitatively in excellent accordance with Voigt's theory. It is certainly very interesting that the theory is able to explain the complicated course of double refraction by the difference between the velocities of propagation of vibrations at right angles and parallel to the field.

Magnetic Resolution and Intensity of Field

Let me again refer to our first subject, the magnetic separation of the lines. The magnitude of this separation is proportional to the intensity of the field in which the source is placed. We may, therefore, deduce the intensity of the field from the magnitude of the magnetic separation. We have only to measure the distance of the components of a suitable line. It is not generally known that

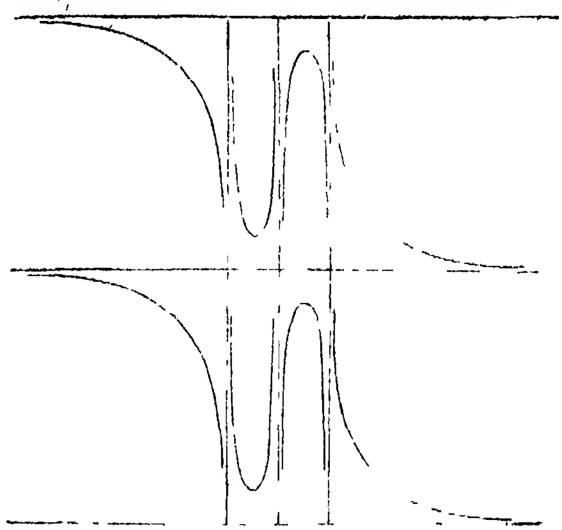


Fig. 6.

Fig. 5.

this distance can be measured with great accuracy (with an error of considerably less than 1 per cent.). It is therefore far easier, if a relatively high degree of accuracy is necessary, to compare the intensities of field by measurements of the distance between the components than by direct magnetic measurements.

All methods used for the measurement of magnetic fields give us the intensity in a point. On the other hand, the magnetic resolution of spectroscopic lines can give us the intensity *in all points belonging to a line*. Moreover, in this manner we make direct use of a property of the atom.

You see here a vacuum tube with some mercury. We heat the tube and excite it with the coil. You notice the brilliant light which is, however, greatly increased when the tube is placed in a magnetic field.[1] For a given density of the vapour there is a definite intensity of field for which the luminosity is a maximum. You can see this when we put on the current in the electromagnet, the intensity of the field then rises gradually.

We project an image of the tube on the slit of a spectroscope. This spectroscope must be so arranged that to every point of the slit there corresponds a point of the image. The blue line of mercury (4359) resolves into a sextet. Using this line, the field of a du Bois electromagnet with a pole distance of 4 mm. is mapped out in the spindle-shaped optical magnetograms now shown (Fig. 8). We may, of course, extinguish the light of the inner components. In some cases a triplet will give more accurate results. The method sketched will, of course, only be applied in difficult cases. So long as our spectroscopes of great resolving power are rather cumbersome there is no practical application for the method. By means of this method we may also study some questions as to the way in which certain phenomena which accompany the resolution depend on intensity of field.

Fig. 7.

[1] Zeeman and Geest, Proc. Acad. of Sciences, Amsterdam, May, 1903; December, 1904. Geest, Thesis, Amsterdam, 1904; Archiv Néerl., sér. 2, T. 10, p. 291, 1905.

[1] Paschen, Physik. Zeitschr. I. S. 47, 1 [illegible]

We have no time, however, to discuss this further, because I should like to refer to the important subject of the

Behaviour of the Different Lines in the Magnetic Field

In many metallic spectra a number of lines occur which are closely related, and form so-called series of lines. The important discoveries of Hartley, Liveing, and Dewar were followed by the discovery of series, owing to the indefatigable efforts of Balmer, Kayser and Runge, Rydberg and Schuster.

The plate shows diagrammatically the arrangement of the three connected series which are found in the spectra of the alkalies and other elements, and which are distinguished by Prof. Schuster[1] as the trunk series (Kayser and Runge's "Hauptserie"), the main branch series (Kayser and Runge's "Zweite Nebenserie"), and the side branch series (Kayser and Runge's "Erste Nebenserie").

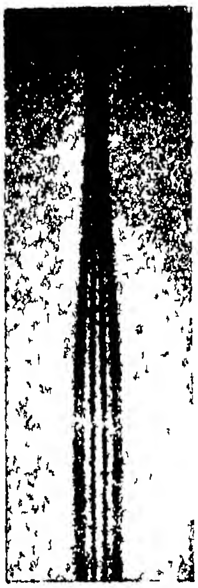


FIG. 8

The laws of these series are simpler than those governing acoustical vibrations. They are of an entirely different character, for instance, the members of each series approach some definite limit of frequency, whereas the number of acoustical vibrations may increase indefinitely.

My first measurements already made it evident that lines of different series behaved entirely unlike each other.[2] Hence the ratio of charge to mass could not be the same for all vibrating electrons.

Runge and Paschen have proved in a most beautiful and systematic investigation[3] that all the lines of a trunk or of a branch behave in the same manner. This result was first announced by Thomas Preston,[4] but it is not stated to what degree of accuracy and for how many lines he investigated the subject.

All lines of the same series are split up in the same manner, *e.g.* all lines are resolved into triplets or all into nonets. Moreover, not only the general type of subdivision is the same, but even the amount of separation when measured in oscillation frequency.

The second law discovered by these physicists is this: That corresponding series of *different* elements show the same type of resolution, and the amount of separation is the same when measured on the frequency scale.

In the alkalies each line of the trunk series is double, and we may speak of a twin trunk. The yellow sodium lines are a typical example. The type of resolution of the two lines is shown in the diagram (Fig. 9). Here we have again our old sodium lines in the field. The same division occurs in all cases when twin trunks exist.

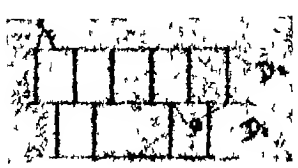


FIG. 9

Substances so different in chemical behaviour as sodium, copper, silver, and calcium (*e.g.* the well known lines H and K), split up in the same manner, and I think that even Sir William Crookes will be surprised to hear that his thallium lines are in the magnetic field only counterfeit sodium lines. I can show you the splitting up of these beautiful thallium lines in the slide.

[1] Schuster, "The Theory of Optics," p. 282, 1904.
[2] Zeeman, Verslagen Ak. v. Wetenschappen, Amsterdam, December, 1897. *Phil. Mag.*, February, 1898.
[3] Runge and Paschen, Berl. Akad. Abhandlungen, Anhang, 1902. Sitzberichte, Berlin, p. 380, p. 720, 1902. Runge, "Physik. Zeitschr.," 3 Jahrgang, S. 441. Kayser, Spektroscopie, Band 2, Kapitel ix., 1902.
[4] Preston, Dublin Trans. (2) 7, pp. 7–22, 1899.

With zinc, cadmium, mercury, and calcium, there are *three* main branches associated with each other. The amount of separation is the same in each of these branches. The type of resolution is shown in the diagram (Fig. 10). I can show you further lines of mercury, the triplet, the sextet, the nonet. Another example of the same sextet is given by a zinc line. The next slide refers to some beautiful magnesium lines exhibiting the same three types of resolution (Fig. 11).

We see that in these cases the simple image of an oscillating electron does not apply. I regret to say that the electronic theory cannot yet give us the explanation of the more complicated resolutions, even for the quartet we are yet in want of a model.

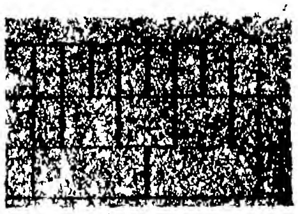


FIG. 10

The laws discovered, however, seem to point to the conclusion that all the lines of a series are emitted by one oscillating system, that there are therefore as many series in the spectrum of a substance as oscillating systems in its atom, moreover, that the oscillating mechanism is the same in different elements. We are reminded here of the view advocated by Sir Norman Lockyer that the different elements have something in common. The relation between these spectral series and resolution in the magnetic field is so close that we may expect that the solution of the problem of the series will give at the same time the solution of the magnetic separation problem.

That Lorentz's theory is on the right track, even in the case of the more complicated magnetic effects, appears from the polarisation of the nonet shown in the slide. Three groups of vibrating lines here correspond to the three lines of the triplet. The circular polarisation corresponds also

FIG. 11

to that of the doublet, indicating that it is always the negative electron which executes the vibrations. There is yet room enough for experimental work in extending these investigations in different directions and to other elements.

Much light on our present subject will be thrown undoubtedly by the activity in adjacent chapters of physics. I can only mention in this relation the extremely interesting experiments by Lenard and Stark on the centres of emission of different spectral series, and the important theoretical work by Drude[1] on the optical properties and electronic theory. Maxwell has said, "an intelligent student armed with the calculus and the spectroscope can

[1] Drude, *Annalen der Physik*, pp. 677, 936, Bd. 14, 1904.

hardly fail to discover some important fact about the interior structure of a molecule" I think this statement remains as true now as it was thirty-two years ago There can be no doubt, I think, that spectrum analysis, and especially the magnetisation of the spectral lines, will give us a clue to the inner structure of the atom I hope that I have succeeded in imparting to you this my conviction

THE ERUPTION OF VESUVIUS IN APRIL, 1906

THE most complete published account of the eruption of Vesuvius in April last is due to the enlightened liberality of the French Government, which commissioned Prof Lacroix to study and report upon the eruption, and it is gratifying to find that this, as all other detailed accounts by qualified scientific observers of the eruption of Vesuvius, confirms in every respect the description which we were able to disentangle from contemporary newspaper reports and publish in our issues of April 12 and 19 As a result of Prof Lacroix's researches he has, in addition to more detailed memoirs published or to come, communicated to the *Revue générale des Sciences* of October 30 and November 15 an interesting account of the result of his observations and deductions, some of which are sufficiently interesting to deserve notice, in extension of what we have already published

The earlier stage of the eruption was of the Strombolian type, that is to say, the material ejected from the crater was formed by the breaking up of molten lava it was consequently red hot, and Prof Mercalli, who was watching the eruption from Torre Annunziata, noticed that the mountain became covered, for from 200 metres to 300 metres from its summit, with a continuous sheet of glowing material, from which blocks incessantly rolled down to lower levels At 0h 31m and again at 2h 40m a m on April 8 violent earthquakes were felt, corresponding to the most violent paroxysms of the eruption, accompanied by a lowering of the height of the cone and a change from the Strombolian to the Vulcanian type of eruption From this time onward the ejected material was less and less composed of fresh lava, and less and less incandescent, being composed, in increasing degree, of the old solidified lavas and tuffs of the cone

For several days after April 8 the summit was hidden by a thick cloud of ashes, and when this cleared away the mountain was found to have changed its form from a pointed to a truncated cone, like that left after the eruption of 1822, though not so low or with so large a crater When it became possible to ascend the cone it was found that the new crater was a true caldera, almost circular, of 640 metres to 650 metres in diameter, surrounded by walls almost vertical, except at the top, where a steep talus reached up to the crest, and at the bottom, where a funnel shaped talus sloped down into a cloud of vapour escaping from the fumeroles The rim was irregular in height and generally sharp-crested, but cut by a deep gap on the north-east, where, for some 80 metres, the crest was not only lower, but comparatively flat-topped, this gap faces the crest of Somma in the direction of Ottajano, where scoriæ and ashes fell in quantity sufficient to crush in the roofs of houses, while the observatory, less than half as far from the crater in the opposite direction, received but a very small quantity of these same ejections Prof Lacroix rejects the explanation that this difference was solely due to wind, and considers that he has established a case of oblique eruption, the average direction of projection being not vertical, but inclined at a considerable angle towards the north-east

The greater part of the material blown out from the crater fell on the slopes of the cone, which was covered many yards deep with a loose deposit of fine dust, ashes and blocks of all sizes Even before the eruption ceased the surface of this deposit began to be broken by dry avalanches, which crashed down on every side leaving the cone deeply scored by a series of radiating valleys, separated by steep-sided, sharp-crested ridges Later on, rain-water sinking into and saturating these loose deposits set them in motion as the well-known mud lavas, the mode of flow of which resembles closely that of the molten lava, and still later the rain-water, flowing off the surface, formed torrents of more liquid mud which cut through the earlier accumulations of the dry avalanches and mud lavas

The eruption was accompanied by a change in level of the land, but this was confined to the immediate neighbourhood of the volcano, for the tide-gauge shows that there was no alteration in the relative level of land and sea at Naples, while Prof Mercalli found an elevation of from 30 cm to 48 cm between Portici and Vico Equense. Of mineralogical interest is the new mineral, of which the first published description appeared in NATURE of May 31, and the discovery of galena as an addition to the list of Vesuvian minerals

RUSSIAN OBSERVATIONS OF THE SOLAR ECLIPSE, AUGUST 30, 1905

CONSIDERING the unfavourable weather conditions experienced by many of the eclipse parties last year the members of the Russian expedition in charge of M A Hansky, are to be congratulated on the results they obtained, which have been recently circulated as a publication of the Pulkowa Observatory The observers were stationed at Alcocebre, on the Mediterranean coast near Valencia The central line of totality passed almost exactly through the station, and various local conveniences combined to render the choice of site favourable to efficient observation On August 15 all the instruments were received in good condition and after observations had been made for determining the azimuth of the sun's rising point, the various pillars and stands for the apparatus were erected

Photographs of the corona were taken on two scales - small pictures with the Bredikhine double photographic telescope furnished with a Zeiss objective of 170 mm aperture and 800 mm focal length, giving a field of 12° 4 in R A and 8° 8 in declination, large pictures, for the delineation of fine detail in the coronal streamers, with an objective of 5 inches aperture and 13 28 m focal length, the light being supplied from a cœlostat 30 cm in diameter Spectroscopic observations of the corona and prominences were made with a direct vision spectroscope without slit, and the polariscopic phenomena examined by the aid of a Savart polariscope Measurements of the solar radiation were taken with an actinometer and actinograph of Crova's pattern

Near the time of eclipse the sky became clouded over, but about a minute before totality the sun was seen in clear sky The corona was seen five or six seconds before totality, and the last ray of sunlight was visible for some two seconds probably through a deep valley in the moon's limb This feature is also shown very clearly in the photograph of the chromosphere accompanying the report which is divided up into a series of bead-like masses at that particular place Visually the corona was seen of a brilliant, silver-white colour, its brightness increasing rapidly towards the moon's limb The longest rays seen extended about one and a half lunar diameters, and were situated near the poles of the sun, one at the north and two very fine ones at the south pole The sky had a green colour, similar to that often seen about half an hour before sunrise Careful examination of the spectrum of the corona during one of the forty-seconds' exposures showed that the continuous spectrum was especially strong in the green, yellow, and red, the latter region being so brilliant that it suggested the possibility of photographing the corona in ordinary daylight by means of suitably prepared colour screens

With the polariscope the coronal light was seen to be strongly polarised and the conditions were such that the dark bands were not visible on the sky surrounding the corona The bands were much stronger when tangential to the sun's limb than when radial There appeared to be a rotation of about 2½° of the plane of polarisation which may possibly be ascribed to the action of a magnetic field round the sun

Eight photographs of the corona were obtained with the long focus telescope, the exposures varying from 40-45

seconds The longest were somewhat over-exposed near the limb, and showed structure to about three-quarters the lunar diameter Six photographs were taken with the Bredikhine coronagraph, the first of which only was successful, most of the others being much over-exposed On the good plate the star ρ Leonis was photographed, thereby giving an accurate means of orienting the plates for determining the position angles of the prominences and coronal streamers These values are tabulated for the more important streamers M Hansky considers that the results obtained confirm the idea that the corona varies, not only in form, but in brightness and spectrum, with the sun spot period During this last eclipse the brightness was probably ten times that of the full moon, while at epochs of minimum spots the corona has only been about as bright as the full moon Owing to the sky being frequently clouded over, the actinometric observations are of only small importance, but the character of the record obtained indicates that Crova's instrument is very convenient for such investigations

Shadow bands were observed before the commencement of totality the direction of their displacement on the ground being from west to east They were badly defined at their edges, but became more definite as totality approached They appeared of a brownish colour and moved with a velocity of 2–3 metres per second the motion being apparently oscillatory and not translatory Their distance apart was not more than 25 centimetres Other observations made at Amposta showed the bands to be 5–7 cm wide and 10–15 cm apart, the displacement being from north-west to south-east At the end of totality the corona disappeared immediately, and no shadow bands were seen The sunlight appeared to return suddenly, without any gradual change such as was observed before totality

CHARLES P BUTLER

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD—The following examiners have been appointed —In zoology Dr J W Jenkinson Exeter College in preliminary physics, R L Baynes, Christ Church, in preliminary chemistry H B Hartley Balliol College, in preliminary animal physiology Prof F Gotch, Magdalen College in preliminary zoology, R W T Gunther, Magdalen College in medicine, Dr A E Garrod Christ Church in organic chemistry N V Sidgwick, Lincoln College in materia medica, Dr R Stockman in anatomy, Prof A Thomson, Exeter College in physiology Dr H M Vernon Magdalen College, in pathology, Prof G Sims-Woodhead, in forensic medicine, Dr H H Littlejohn in surgery D'Arcy Power Exeter College, in obstetrics, J S Fairbairn Magdalen College

Dr J W Jenkinson, Exeter College, has been appointed lecturer in comparative and experimental embryology

T Lindsay Glasgow University, has been elected to a Brakenbury scholarship in natural science at Balliol College

An examination for a Radcliffe travelling fellowship of the annual value of 200*l*, tenable for three years will commence on February 26, 1907 Intending candidates should send their names to the regius professor of medicine by February 9

CAMBRIDGE—Mr A G Tansley assistant professor of botany at University College, London, has been appointed lecturer in botany in succession to Mr A C Seward, who has succeeded the late Prof Marshall Ward in the chair of botany

The Vice-Chancellor has published a further list of donations to the benefaction fund which has now reached a sum of 96,400*l*

Mr L G Bedford of Sidney Sussex College has been appointed assistant demonstrator at the Cavendish Laboratory to hold office from January 1, 1907 to September 30, 1911

Prof B Hopkinson has been appointed chairman of the examiners for the mechanical sciences tripos, 1907

The Arnold Gerstenberg studentship (1906) has been awarded to A E Baker, Trinity College, for an essay entitled "A Critical Examination of Descartes' Philosophy of Nature"

The special board for biology and geology has adjudged the Walsingham medal for 1906 to W E Agar, for his essay on "Researches into the Embryology of the Dipnoi," and W L Balls, for his essay entitled "Studies of Egyptian Cotton"

It is proposed that, in accordance with a recommendation of the general board of studies, a university lecturer in hygiene be appointed for a period of five years, in connection with the special board for medicine, and with an annual stipend of 100*l* payable out of the funds in the hands of the State Medicine Syndicate

The authorities of Gonville and Caius College, having decided to close their chemical laboratory at the end of the present academic year, a syndicate was appointed on November 8 to consider the assignment of a site for the extension of the chemical laboratory The conclusion arrived at is that, of the sites available, the one site which is not liable to considerable objection lies between the chemical laboratory and the new medical schools, with a frontage next Pembroke Street

The antiquarian committee recommends that it be authorised to hire an old malting house at Newnham for a period of five years in which to store some of the collections under its charge The need for a new museum of ethnology and archæology is indeed becoming pressing The University has assigned a site for such a building and a building fund has been started by Baron von Hügel curator of the museum but until that fund is very considerably augmented the University will be compelled to store away many of its treasures in a building inaccessible to students, and quite unworthy of the treasures it contains The committee also recommends that the numerous small sums which it receives from the financial board for the upkeep of the museum be consolidated and that an annual grant of 420*l* be placed at its disposal for each of the five years 1907 to 1911

THE fourth annual prize distribution of the Sir John Cass Technical Institute was held on December 4, when Sir William Ramsay, K C B, F R S delivered an address and distributed the prizes The chair was taken by Sir Owen Roberts, chairman of Sir John Cass's foundation In reviewing the work of the institute Sir William Ramsay dwelt upon the scope and aims of those who follow the study of science with the view of making discoveries whose main object is to extend the boundaries of science and to gain knowledge, in contrast with those who on the one hand, restrict their work to duties of a more mechanical character, involving less responsibility and are satisfied with the discharge of their daily task and with those, on the other, who find their work and interest in the direction and guidance of business concerns and in the control of their fellow-men The comparative rewards and the nature of the successes of these various classes of workers were contrasted and the possibilities of the Institute in training students to fill one or more of these different spheres of activity were outlined Turning to the awards made on the work of the past session Sir William Ramsay advised students not to aim at prizes, if prizes come, well and good but they should not be the object of work The chief aim, he said, should be to get on with the work in hand to do it as well as possible, even if the labour brings no immediate reward, and to seek for knowledge for the great thing in life generally is to be and not to get Previous to the distribution, Mr George Baker, chairman of the institute committee, made a short statement of the work of the institute in which he pointed out that its relation to the industries of East London is beginning to be known and appreciated by manufacturers and expressed the hope that it would in the course of time prove a real and progressive help to the trades and industries of the district

SOCIETIES AND ACADEMIES.

LONDON

Royal Society, June 28.—"The Pharmacology of Ethyl Chloride." By Dr. E. H. **Embley.**

Four years ago Dr. Embley published the result of an investigation into the pharmacology of chloroform which he had carried out in the physiological laboratory of the University of Melbourne,[1] primarily with the view of elucidating the cause of those sudden misadventures which occur in chloroform administration, and more particularly during the early period of the induction of the anæsthetic.

Dr. Embley's work, however, covered the whole subject of the physiological action of chloroform in a very thorough manner, and perhaps one of the most striking merits which it possessed was due to the fact that the experiments were conducted throughout with definitely known percentages of chloroform in the air respired.

The present work on ethyl chloride is conducted in the same quantitative manner, and with the same command of physiological technique, as shown by the excellent graphic records which illustrate the paper.

Ethyl chloride was first used as a general anæsthetic in 1848 by Heyfelder. It subsequently fell into disuse, but was revived in 1895. Its position is intermediate between nitrous oxide and chloroform or ether.

According to Embley, blood absorbs more than twice as much of the gas as water under similar conditions, so that ethyl chloride, like chloroform, evidently enters into loose chemical union with the blood.

The first point ascertained was the direct effect of ethyl chloride upon the mammalian heart.

Isolation of the heart was obtained by ligation close to the aorta of all the systemic arteries, except the subclavian. By this procedure the circulation was confined to the heart, lungs, and one limb, the nervous system being cut off from its blood supply is instantly put out of action. The pressure in this miniature circulation was recorded by a manometer connected with one carotid artery.

The effect of ethyl chloride upon heart muscle, as is the case with chloroform, and in contrast to ether, was paralytic, but the quantity of ethyl chloride vapour in the air required was nineteen times as great as that of chloroform to produce comparable results.

The direct influence of ethyl chloride upon the arterioles was demonstrated by driving an artificial circulation first through the isolated lungs and then through the isolated intestine of an animal, and measuring the outflow before, during, and after the admixture of definite percentages of ethyl chloride in the air rhythmically pumped into the lungs.

The administration of air containing 20 per cent. to 30 per cent. of ethyl chloride was found directly to paralyse the arterioles. The effect upon the vasomotor system in the intact animal was studied by taking simultaneous records of the arterial blood pressure and of the volume of various organs. These experiments showed that with 20 per cent. to 30 per cent. ethyl chloride in the air respired, a considerable degree of paralysis of the vasomotor system occurred.

Vagus inhibition of the heart was found readily to occur when above 9 per cent. of ethyl chloride vapour was present in air. Between 10 per cent. and 20 per cent. inhibition caused sudden fall of blood pressure and cessation of circulation. These effects upon the heart were due to stimuli passing down the vagi from the central nervous system, for on cutting these nerves the circulation was instantly resumed. This sudden inhibition of the heart was not, however, nearly so dangerous as the same effect easily produced by chloroform, for the direct paralytic effect of ethyl chloride upon the heart muscle is comparatively insignificant, so that in the majority of cases recovery of the circulation readily occurred if the administration were suspended.

The effect of ethyl chloride upon the respiration is also dealt with. Ethyl chloride gradually reduces the rate and extent of the respiratory movements, and if pushed in sufficient concentration will ultimately lead to their cessation. The same interdependence between respiratory activity and blood pressure was brought out, as had been shown by Leonard Hill and the author, to obtain in chloroform poisoning. Provided the circulation were maintained, it was found nearly impossible to produce cessation of respiration, but directly serious fall of blood pressure occurred, owing to inhibition of the heart, the respiration immediately became very shallow or ceased, but returned again directly the circulation recovered.

The primary danger in the administration of ethyl chloride to dogs, as in the case of chloroform, is syncope from inhibition of the heart, brought about by the stimulating action of these drugs upon the cardiac-inhibitory centre in the medulla. As it is a stimulating action, it is more prone to occur in the early stages of administration before these nerve centres are themselves narcotised by the drug.

"Refractive Indices of Water and Sea-water." By J. W. **Gifford.** Communicated by W. A. Shenstone, F.R.S.

Reference is made to previous papers (Roy. Soc. Proc., February 13, 1902, and March 3, 1904). The same special method of observation has been adopted. Measurements of the refractive index of water for twenty-six wave-lengths and of sea-water for twelve wave-lengths are contained in the paper. Those of sea-water were made for the purpose of computing an under-water lens since successfully constructed for submarine use. The measurements were made at an approximate temperature of 15° C., but were also corrected by means of temperature refraction coefficients.

The error is estimated as in no case exceeding 0.000025, and in most cases not exceeding 0.000015. The index of water for line D, reduced to 20° C. by the temperature coefficient, is 1.333032. Dufet ("Recueil de Données numériques," vol. i., p. 83) gives 1.33303 as the mean of the measurements of twenty-nine different observers for that line and temperature. The measurements were made on the goniometer used before (loc. cit.), but have been checked by critical work on a much larger instrument.

The distilled water was prepared in platinum vessels by Mr. Bousfield; the sea-water was taken five miles from shore by Lieut. J. R. G. Evans, R.N.

November 8.—"On a Compensated Micromanometer." By B. J. P. **Roberts.** Communicated by Sir John I. Thornycroft, F.R.S.

The principle of the gauge is similar to that of Sir W. Siemens's bathymeter. The instrument described consists of a U tube having the limbs connected by a tube of small bore, the motion of the fluid in this small-bore tube being rendered visible by means of an air bubble index. The sensitiveness depends on the ratio between the bores of the limbs and the connecting tube, and also partly on the nature of the fluid employed. The fluid should have a low surface tension, and the bore of the connecting tube should preferably not exceed 1.5 millimetres. The length of the bubble should be made equal to the distance between the centres of the upright limbs—the readings will then be practically unaffected by changes of level; the readings are also indifferent to vibration or similar disturbing causes. No fluid will pass the bubble provided certain precautions are observed—of these the most important is keeping the rate of movement of the bubble from exceeding certain limits. An attachment for preventing loss of fluid by evaporation is suggested in some cases.

"The Composition of Thorianite and the Relative Radio-activity of its Constituents." By Dr. E. H. **Büchner.** Communicated by Sir W. Ramsay.

Various investigations on residues from the mineral thorianite, carried out in the laboratory of Sir William Ramsay, made it desirable to analyse a large amount of this mineral, and to determine how its radio-activity is distributed over its constituents. About 24 grams were dissolved in boiling nitric acid, and left only a small residue behind, which was then fused with hydrogen potassium sulphate. The fused mass dissolved almost completely in water. The solutions obtained were then treated in the ordinary way and separated in the various groups. Pb, Cu, Sn, Sb, Fe, Al, Ur, Th, Ce, Zr, Ti, Ca, He, CO and water were quantitatively determined; the greater part of these elements are present in very small quantities.

[1] "The Causation of Death during the Administration of Chloroform" (*British Medical Journal*, April 5, 12 and 19, 1902).

The determination of the more important ones gave the following results:—PbO, 2·42 per cent.; Fe_2O_3, 3·35 per cent.; Ur_3O_8, 13·12 per cent.; ThO_2, 70·96 per cent.; Ce_2O_3, 1·96 per cent. From 1 gram of the mineral 8·2 c.c. of helium were obtained. The original mineral possesses 83·3 per cent. of the activity of standard uranium oxide. The greater part of the constituents proved to be radio-active, though some only in a very slight degree. Nearly 60 per cent. of the activity of the mineral is allied to the thorium, about 9 per cent. to the uranium. The strong activity of the iron appears to be due to the presence of Hahn's radio-thorium. The activity of several precipitates increased during the time between two measurements, while others showed a decreasing activity, which sometimes even disappeared. It may be assumed that these precipitates are so-called X-substances; one of them resembles in its chemical behaviour a platinum metal.

Zoological Society, November 13.—Mr. Howard Saunders, vice-president, in the chair.—A very young embryo of the okapi (*Okapia johnstoni*) obtained by Dr. F. David from a specimen shot in the Semliki Forest: Prof. R. **Burckhardt**. The object not being well preserved and in an early stage, it could only be stated that all the particulars ascertainable were specially ungulate in character.—Description of a new species of turbellarian obtained during Dr. W. A. Cunnington's expedition to Lake Tanganyika: F. F. **Laidlaw**.—List of a second collection of mammals made in Western Australia for Mr. W. E. Balston, with field-notes by the collector, Mr. G. C. Shortridge: Oldfield **Thomas**. This second collection was made in the Avon watershed, and consisted of about 350 specimens, of which a fine series had been presented to the National Museum by Mr. Balston. In all, forty-two species were enumerated, and of these Mr. Shortridge gave notes on the distribution and comparative rarity at the present time, such notes being of particular value in the case of a disappearing fauna like that of Australia. An appendix dealt with a small series obtained on Bernier Island, Shark's Bay, on the north-west coast of Australia.—Sixth instalment of the results of the Rudd exploration of South Africa: Oldfield **Thomas** and H. **Schwann**. This contained an account of the mammals obtained by Mr. C. H. B. Grant in the eastern Transvaal. Twenty-one species were represented in the collection, of which one was new.—The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the collections of Mr. F. W. Townsend, 1903–5, with descriptions of new species, part ii., Pelecypoda: J. Cosmo **Melvill** and R. **Standen**. A continuation of the enumeration of the Mollusca of the above-named seas published in the Proc. Zool. Soc., vol. ii., 1901, and completing the catalogue, the total number embraced being nearly sixteen hundred species, many of these being found to be new to science. Among the Pelecypoda, Tellina holds the premier place; most orders and families are, however, represented, and the result is a very refined and varied molluscan fauna. Some interesting forms occur among the Cardiacea, while the Pectinidæ show alliance and, in some cases, specific identity with the Erythræan fauna, monographed by Dr. Sturany.

November 27.—Mr. Howard Saunders, vice-president, in the chair.—Notes on the habits of the lesser horseshoe bat, *Rhinolophus hipposiderus*: T. A. **Coward**. This bat usually occupies different retreats in summer and winter, and during the earlier period of occupation of the winter retreat sleep is not profound. The bats feed probably in the caves or retreats, and the food is at times, if not always, consumed when the animal is at rest and not on the wing. When feeding it does not—probably could not—make use of the interfemoral membrane, after the manner of the Vespertilionidæ, but, as a substitute, the interbrachial membrane is employed. These facts suggest that the hibernation of this species, and probably of other cave-haunting bats, is not really a profound winter sleep.—An account of four species of Solenidæ contained in the collections made by Mr. Cyril Crossland in Zanzibar and British East Africa in 1901–2: F. A. **Smith** and H. H. **Bloomer**.—Attempt to explain the existence of the so-called "renal-portal" system: W. **Woodland**.—The anatomy of *Centrophorus calceus*: W. **Woodland**. The author described in particular the anatomy of the alimentary tract, which differs in several respects from that of most Selachians, and, as regards the length of the bile-duct, from most vertebrates.—Mammals collected in Korea and Quelpart Island by Mr. Malcolm P. Anderson for the Duke of Bedford's exploration of Eastern Asia: Oldfield **Thomas**. The collection consisted of about 130 specimens, belonging to nine species, of which four were described as new. Quelpart Island proved to contain a very poor mammal fauna, and the only specimens obtained there were a Putorius and a Micromys, both identical with forms found on the Korean Peninsula.

Linnean Society, November 15.—Prof. A. W. Herdman, F.R.S., president, in the chair.—A series of twenty-one specimens of *Polygala amarella*, Crantz, selected to show its wide range of form under various conditions: J. **Cryer**.—The Fjærlands Fjord, Norway: H. W. **Monckton**. During the past summer the author spent a fortnight at Mundal, on the Fjærlands Fjord, and he had paid short visits to the same place in previous years. The fjord is a long arm running from the Sogne Fjord in a north-easterly direction, and snow-fields lie near the fjord on both sides, though at a considerable altitude above it. Mundal is about ninety miles from the open sea, but Fucus grows well on the rocks and foreshore, and Mytilus and Cardium flourish. The author considered, among other subjects, the question to what extent the snow-fields and glaciers of Norway can be looked upon as relics of the Glacial period.

Anthropological Institute, November 20.—Prof. W. Gowland, president, in the chair.—A visit to the Hopi Indians at Oraibi: W. **Crewdson**. The visit took place in November, 1905, when it was late to travel across the plains of Arizona; but by starting from Canyon Diablo, on the Santa Fe route, with relays of horses, the seventy miles to Oraibi was accomplished in one day. Oraibi is the most conservative of Indian towns, practically unaltered by Western civilisation, and shows examples of primitive life in our own days, several of the implements used being still of stone; the bows and arrows and boomerangs are also used for killing game. One of the most striking characteristics of the Hopi men is their marvellous power of running; for this they are trained as children by one of the chief men, who stands on one of the Mesas and sees the young men take a twenty-mile run before commencing the day's work. The necessity for this was owing to their fields being many miles distant from their homes. The result is that a Hopi will sometimes run forty miles to his fields, cultivate them, and then run home again, all within the twenty-four hours. In the house, which is built by the woman, she rules absolutely; the children take the mother's name, the men weave the garments for both themselves and their wives, and are at any time liable to be definitely turned out of their homes, possibly after a forty-mile run, by the wife who has grown tired of her husband. These Indians are intensely religious, most of their ceremonies, which often last for days, being really prayers for rain. Their pottery is interesting, being decorated to a large extent with cloud symbols, and many pieces have a break in the design to allow the spirit which is supposed to be imprisoned in the design free ingress and egress. This idea bears a curious resemblance to the idea, once prevalent in England and elsewhere, that if a circle was drawn round a witch she could not escape unless someone cut the circle for her from outside. The celebrated snake-dance, which has been so often described, takes place in August, and it is becoming more and more probable that these Indians are really acquainted with a cure for snake bite. In November, however, the dance of the year, only second to the snake-dance, and called the basket-dance, takes place. The lecturer was present at this, having previously been admitted to the Kiwa, or underground chamber, where the preparatory rites in connection with the ceremony take place.—The relative stature of the dolichocephalic, mesaticephalic, and brachycephalic inhabitants of East Yorkshire: J. R. **Mortimer**. The inhabitants are divided into two classes: those of the Neolithic and Bronze period,

and those of the Early Iron period Of those in the first class, the dolichocephals are found to have the greatest stature and the mesaticephals the smallest stature while in the second class the mesaticephals have the greatest stature and the brachycephals the shortest stature There is, therefore, no simple relation between stature and skull length. The number of skulls examined was 151

Geological Society, November 21 —Sir Archibald Geikie, Sec.R.S., president, in the chair —The Kimeridge Clay and Corallian rocks of the neighbourhood of Brill (Buckinghamshire) A. M **Davies** The paper contains two principal divisions —(1) an account of the section of Rid's Hill, Brill, (2) the rock of Studley and Arngrove, described by Phillips as an argillaceous chert, is shown to be mainly composed of the globate spicules of the tetractinellid sponge Rhaxella. Palæontological notes are given on certain species of Lamellibranchia and Annelida, chiefly from the Lower Kimeridge Clay —The skull and greater portion of the skeleton of *Goniopholis crassidens* from the Wealden Shales of Atherfield (Isle of Wight) R W **Hooley** In the late autumn of 1904, at a place locally called "Tie Pits," near Atherfield Point, a huge mass of the cliff, comprising many thousand tons of the Wealden Shales, subsided, pushing its foot across the beach until below low-water line As the sea washed away the base, the mass continued to sink, and fresh horizons were denuded In 1905 a series of heavy "ground-seas" cast up blocks of limestone and ironstone, containing crocodile bones, which were discovered on the sand between high- and low-water marks The skull came ashore in six pieces Fragments of bones and scutes were constantly picked up The specimens were derived from a horizon 80 feet to 90 feet below the top of the Wealden Shales

Entomological Society November 21 —Mr F Merrifield, president, in the chair —*Exhibitions* H W **Andrews** Specimens of *Odontomyia angulata*, Pz, from the Norfolk Broads, of which species few captures have been recorded of recent years, and *Icterica westermanni* Mg, a rare Trypetid taken in the New Forest —Dr F A **Dixey** Specimens of South African Pierinæ demonstrating that the wet-season form of *Teracolus regina* Trim is in mimetic association with an undescribed species of Belenois, intermediate between *B calypso* and *B thysa* —H and F **Campion** A male specimen of *Sympetrum vulgatum* taken in Epping Forest on September 4 last, of which species there are recorded only three other authentic British specimens —R **Adkin** A short series of *Tortrix pronubana*, Hb, including both sexes, reared from larvæ and pupæ collected from euonymus at Eastbourne in September The only previous records for the species in Britain are single male examples captured at Eastbourne and at Bognor —Dr T A **Chapman** A long series of *Coenonympha mathewi*, Tutt, from different places in the north-west corner of Spain (Galicia), and from which it was concluded that *C mathewi* is a geographical or subspecific variety of *C dorus*, and not a fully established species.—*Papers* —A permanent record of British moths in their natural attitudes of rest, and Further notes on the choice of a resting site by *Pieris rapae* A H **Hamm** —Studies of the Blattidæ R **Shelford** —Notes on the life-history of *Sesia andrenaeformis*, Lasp Hon N Charles **Rothschild** —Notes on an unusual emergence of *Chrysophanus salustius* in New Zealand H W **Simmonds**.

PARIS

Academy of Sciences, December 3 —M H Poincaré in the chair —A new and rapid method for the determination of the errors of division of a meridian circle M **Lœwy**. A continuation of previous papers on the same subject The method is modified to allow of the direct determination of the correction of the twenty standard points —The specific adjuvants of experimental parthenogenesis Yves **Delage** It has been found that the addition of certain salts to the solution usually employed in parthenogenesis (common salt, sea water, and distilled water) considerably augments the power of the latter as a parthenogenetic agent Such substances are the chlorides of manganese, cobalt, and nickel, the last-named being the most active This result is unexpected, and no satisfactory explanation has as yet been found Different eggs, even from the same ovary (of the sea-urchin), present considerable differences, differences which neither the superficial nor histological examination offer any assistance in explaining —Concerning the expedition organised for the study of sleeping sickness A **Laveran**.—Pulmonary physiological anthracosis of intestinal origin MM **Calmette, Vansteenberghe**, and **Grysez** A repetition and extension of previous experiments in answer to the objections raised by other workers on the same subject, especially Kuss and Lobstein The authors conclude, in confirmation of their previous work, that besides anthracosis of respiratory and pure mechanical origin, the existence of which they have never denied, it is necessary to admit the existence of physiological anthracosis of intestinal origin —Observations of the comet 1906*h* made with the large equatorial of the Observatory of Bordeaux Ernest **Esclangon** The observations were made on November 22 and 23 and give the apparent positions of the comet and mean positions of the comparison stars The comet appeared as a uniform nebulosity 30″ in diameter, and without apparent nucleus —Observations of the Thiele and Metcalf comets (1906*g* and 1906*h*) made at the Observatory of Algiers MM **Rambaud** and **Sy** The observations were made on November 13 14, 16, 19, and 20, the last night furnishing the best results On November 20 the comet 1906*h* appeared as an irregular nebulosity, the lustre being comparable with that of a star of the twelfth magnitude —Observation of the Metcalf comet (1906*h*) made at the Observatory of Lyons J **Guillaume**. A single observation on November 20 The comet had the appearance of a circular nebulosity of about 30″ diameter, with a central condensation and a small nucleus Its lustre was about the eleventh magnitude —Certain transcendental numbers Edmond **Maillet**.—The critical points of inverse functions A **Hurwitz**.—Periodic functions P **Cousin** - The diffusion of solutions of copper sulphate in gelatin M **Yegounow** Copper sulphate appears to enter into combination with gelatin, but its movement rigorously follows Stefan's law —Potential equalisers M **Moulin** The combustion of filter paper impregnated with quantities of lead nitrate varying from 2 per cent to 5 per cent according to the conditions of wind, has given accurate results The use of flames or radium salts requiring many precautions has been found less practical —Researches on gravitation N **Crémieu** —A theoretical explanation of the magneto-optic phenomena observed in a crystal Jean **Becquerel** —An apparatus for compensating the inertia of selenium A **Korn** A device for overcoming the inertia of the selenium cell in telephotography —Positive charge at a distance in an electric field under the influence of ultra-violet light Mme **Baudeuf** —The reduction of oxide of chromium by boron Binet **du Jassonneix** The reduction of oxide of chromium by boron in magnesia crucibles at the temperature of the electric furnace gives ingots attackable by hydrofluoric, hydrochloric and sulphuric acids These may contain from 5 per cent to 17 per cent of combined boron If boron is present in higher proportions it exists as the carbide of boron The boride CrB constitutes the limit of saturation of chromium by boron —An extremely sensitive method for the precipitation of zinc Gabriel **Bertrand** and Maurice **Javillier** The method is based on the production of a crystallised insoluble calcium zincate Quantitative determinations of zinc can be made in this way in solutions containing only two parts of zinc in a million Even at ten times this dilution the zinc can be qualitatively detected with certainty —Nitriles and carbamines P **Lemoult** Determinations of the heats of combustion and formation of methyl and ethyl carbamines From thermochemical data hydrocyanic acid is considered to be a carbamine and not a nitrile —The action of reagents on ethyl glyoxylate L J **Simon** and G **Chavanne**. The ethyl glyoxylate was prepared by the electrolysis of ethyl oxalate, and its reaction with phenylhydrazine, hydroxylamine, and semicarbazide studied —The esterification of arsenious anhydride by alcohols and phenol V **Auger** A limited amount of alkyl ester is produced by heating together arsenious anhydride and the anhydrous alcohol If the experiment is arranged so that the water produced in the reaction is removed (with

calcium carbide), a good yield of the arsenite is produced The physical properties of propyl, normal butyl, and isobutyl arsenites are given —The orthosubstituted azo-acids and their transformation into *c*-oxyindazylic derivatives P **Freundler** —The condensation of oxalacetic ester with cyanacetic ester in presence of piperidine Ch **Schmitt** The condensation can take place in two ways, giving rise to isomeric substances possessing different properties —The replacement of hydroxyl of some carbinols by the radical $-CH_2CO_2H$ R **Fosse.**—The constitution of hordenine E **Léger.** The regulated oxidation of acetyl-hordenine with potassium permanganate gives acetyl para-oxybenzoic acid This fixes the orientation of the hydroxyl group in hordenine which is thus found to be para-oxyphenylethyldimethylamine —The volcanic rocks of the peninsula of Cape Verde (Senegal) Jean **Chautard** —The presence of galena amongst the minerals produced by the fumerolles of the last eruption of Vesuvius Ferruccio **Zambonini** Referring to a recent paper by M Lacroix on this subject, the author mentions that he contributed a paper on the same subject to the Accademia dei Lincei in August last —The intracellular inclusions of the leaf of *Rhamnus cathartica* Wladimir **Tichomirow** —The evolution of the metachromatic corpuscles of seeds during germination J **Beauverie** —The histological modifications produced in the flowers of *Teucrium Chamaedrys* and of *Teucrium montanum* by the larvæ of Copium C **Houard** —The coral formations of the island of San-Thome, Gulf of Guinea Ch **Gravier** —A respiratory calorimetric room M **Letulle** and Mlle **Pompilian.** A diagram is given of the apparatus which allows of simultaneously measuring the respiratory exchanges and heat evolved by a man over a long period The heat is determined by reading the inlet and outlet temperatures of a measured flow of water, the regulation of the temperature of the calorimeter being made automatically at any desired point between 12° C and 24° C The apparatus was standardised electrically with a possible error of 0 5 per cent —The *rôle* of the chromotropic phenomena in the study of biological and psychophysiological problems Romuald **Minkiewicz** The prophylaxy of glandular cancer of the prostate A **Guépin** —The production in medicine of static effects by high frequency resonators H **Guilleminot**

DIARY OF SOCIETIES

THURSDAY DECEMBER 13

ROYAL SOCIETY, at 4 30 —The Relation between Breaking Stress and Extension in Tensile Tests of Steel A Mallock F R S —On the Intensity of Light Reflected from Transparent Substances Prof R C Maclaurin —Contributions to our Knowledge of the Poison Plants of Western Australia, Part ii, *Oxylobium parviflorum* Lobine E A Mann and Dr W H Ince —Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases F W Aston —An Examination of the Lighter Constituents of Air J E Coates —The Velocity of the Negative Ions in Flame F Cold —The Electric or Magnetic Polarisation of a Thin Cylinder of Finite Length by a Uniform Field of Force Dr T H Havelock —Further Observations on the Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness H G Plimmer

SOCIETY OF ARTS, at 4 30 —The Indian Mohammedans their Past Present and Future A Yusuf Ali

LONDON INSTITUTION at 6 —Tadpoles—a Study in Embryology D J W Jenkinson

MATHEMATICAL SOCIETY at 5 30 —On the Form of the Surface of a Searchlight Reflector C S Jackson —The Potential Equation and Others with Function given on the Boundary L F Richardson —On the Limits of Real Variants J Mercer —The Asymptotic Expansion of Integral Functions defined by Generalised Hypergeometric Series Rev L W Barnes —The Diophantine Equation $x^n - Ny^n = z$ Major P A MacMahon —The Uniform Convergence of Fourier's Series Dr E W Hobson

FRIDAY DECEMBER 14

PHYSICAL SOCIETY 7 p m to 10 p m —Second Annual Exhibition of Electrical, Optical, and other Physical Apparatus

ROYAL ASTRONOMICAL SOCIETY, at 5 —(1) Observations of Comet *c* 1905, and Comets *a* and *b* 1906, from Photographs taken with the 30 inch Reflector of the Thompson Equatorial (2) Pogson's Observations of U Geminorum edited by H H Turner Royal Observatory, Greenwich —Hansteen's Eclipse at Stiklastad 1030 August 31 P H Cowell —The Proper Motion of Castor A C D Crommelin —Note on some Proper Motions derived from a Comparison of Carrington's Catalogue 1855 W G Thackeray —Note on the Approaching Return of Halley's Comet A C D Crommelin —On the Accidental Production of Temporary Errors of Division on a Graduated Circle W M Witchell —*Probable Papers* (1) Note on Silicon in the Chromosphere (2) The Enhanced Lines of Iron in the Region C to F A Fowler —Estimate of the Number of Stars within Certain Limits of Proper Motion W G Thackeray —Discussion (*time permitting*) Possibility of Improving the Places of Reference Stars for the Astrographic Catalogue H H Turner —Solar Parallax Papers, No 5, Photographic Places of Stars in the Paris *Eros* Circular A R Hinks

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mechanical Improvements in the Drainage of the Bedford Level A Carmichael

INSTITUTION OF MECHANICAL ENGINEERS at 8 —*Discussion*, Steam as a Motive Power for Public Service Vehicles T Clarkson.—*Probable Paper*—Lighting of Railway Premises, Indoor and Outdoor H Fowler

MALACOLOGICAL SOCIETY, at 8 —Description of *Latirus* (*Peristernia*) *Sowerbyi* sp n J Cosmo Melvill —On the Anatomy of *Tagelus gibbus* and *T divisus* H H Bloomer —Descriptions of two New Helicoid Forms from German New Guinea J H Ponsonby

MONDAY, DECEMBER 17

SOCIOLOGICAL SOCIETY, at 8 —Sociology as a Province of Biology M Maxweller

SOCIETY OF ARTS, at 8 —Artificial Fertilisers Potassic Fertilisers A D Hall

INSTITUTE OF ACTUARIES, at 5 —On the Error Introduced into Mortality Tables by Summation Formulas of Graduation G King

TUESDAY, DECEMBER 18

ROYAL STATISTICAL SOCIETY, at 5

SOCIETY OF ARTS at 8 —Basket Making Thomas Okey

INSTITUTION OF CIVIL ENGINEERS, at 8 —Mechanical Considerations in the Design of High tension Switch gear H W E Le Fanu

WEDNESDAY, DECEMBER 19

SOCIETY OF ARTS at 8 —Modern Developments of Flour milling A E Humphries

ROYAL METEOROLOGICAL SOCIETY, at 7 30 —The Guildford Storm of August 2 1906 Admiral J P Maclear The Metric System in Meteorology R Inwards

ROYAL MICROSCOPICAL SOCIETY at 8 —Exhibition of Slides from the Collection presented to the Society by Mr Jas. Hilton

THURSDAY DECEMBER 20

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —The Track Circuit as Installed on Steam Railways H G Brown

LINNEAN SOCIETY, at 8 —Botanical Results of the Third Tanganyika Expedition, 1904 5 Dr A B Rendle and others —Fossil Foraminifera of Victoria the Balcombian Deposits of Port Phillip F Chapman —*Exhibition* Albino Woodlice Wilfred Mark Webb

CHEMICAL SOCIETY, at 8 30 —A New Laboratory Method for the preparation of Hydrogen Sulphide F R L Wilson —The Reaction of Acids with Methyl Orange V H Veley —(1) Contributions to the Study of the Calcium Phosphates I The Hydrates of the Calcium Hydrogen Orthophosphates (2) Contribution to the Study of the Calcium Phosphates II, The Action of Ammonia Gas on the Calcium Hydrogen Orthophosphates H Bassett, jun

CONTENTS

THURSDAY, DECEMBER 20, 1906

TWO HISTORIES OF CHEMISTRY

A History of Chemistry from Earliest Times to the Present Day. By Ernst von Meyer. Translated by George McGowan. Third English edition, translated from the third German edition with various additions and alterations. Pp. xxvii+691. (London: Macmillan and Co., Ltd.) Price 17s. net.

A History of Chemistry. By F. P. Armitage. Pp. xx+266. (London: Longmans, Green and Co., 1906.) Price 6s.

PROF. OSTWALD, who has done so much for the historical side of the literature of chemistry, has declared that "there is no more effective means of vivifying and deepening the study of a science than to saturate one's-self in its history." And perhaps of no science can this be more emphatically said than of chemistry. The story of its rise and development is one of the most astonishing and most deeply interesting chapters in the history of human progress. No one science can show such a splendid succession of material triumphs or afford a more striking exemplification of the truth and wisdom of Bacon's aphorism that *Scientia est potentia*. It matters little that the desire to know may have had its origin in the lowest motives of self-interest. No doubt at all times in the history of the world there have been persons curious to know for the mere sake of knowing—persons, indeed, who deliberately preferred the risk of the possible unhappiness of wisdom to the apparently certain bliss of ignorance; but such persons have always been in a vast minority. But in the main the springs of human activity—intellectual no less than physical—have their origin in an enlightened self-interest. However "pure" a science may be to its votaries, there is a good deal of human nature in it after all, and when we come down to ultimate causes it is precisely this aspect of the matter that gives to the history of chemistry its strong human interest, and makes the personal story of its cultivators so fascinating.

Teachers of chemistry do wisely, therefore, in encouraging their pupils to make themselves familiar with the main outlines of the origin and growth of their science, and since it is impossible to separate this development from the human element which underlies it, to seek also to know something of the personal history and attributes of the men who have combined to make chemistry what it is. Luckily they have not far to seek for historical compilations worthy to be recommended for such a purpose. Practically every nation that zealously cultivates chemistry has furnished its contribution to the general stock of such compilations in obedience to, or in anticipation of, a demand which from the very nature of the case is inevitable. To a large extent the several histories may be said to reflect the popular estimation of the science in the countries which produced them. The monumental work of Kopp made its appearance at the period of, and possibly in consequence of, the national movement which originated with Liebig; and Hofer's "Histoire de la Chimie" was in like manner the probable outcome of the activity in France which had its rise with Lavoisier. No original systematic work of the same character, certainly none of commensurate importance, has been put together by any English historian. Certain of our larger manuals contain by way of introduction some historical account of the origin and development of the science, and a few monographs or biographies of the better known British chemists have appeared from time to time, but as regards systematic works we are dependent upon translations of foreign treatises.

Chief among these is the work of Ernst von Meyer, which made its first appearance in 1888, and of which an English translation by Dr. McGowan was published in 1891. The volume before us is the third English edition. It has been prepared from the third German edition, published in 1905, and, thanks to the various additions and alterations which Dr. McGowan has introduced with the sanction of the author, the history is, as the phrase goes, thoroughly up to date. The main divisions of the work remain very much as before, but some of the sections have been recast and much new matter has been added and old matter altered. For example, the author has not failed to take note of the results of recent inquiries into the life and work of that most remarkable man Paracelsus, who, as the researches of Mook, Schubert, Sudhoff, Aberle, and Strunz agree in showing, was by no means the bombastic charlatan he is commonly supposed to be. The mystery of Basil Valentine is submitted to a new examination, but the conclusion does not materially differ from that already arrived at by Kopp. But it is mainly in its account of the recent development of the science that the book differs from the works of Kopp and Hofer. Kopp, in his "Entwickelung der Chemie in der neueren Zeit," only carried his history down to the beginning of the last third of the nineteenth century, a time we can no longer consider new—and the generation that has followed has witnessed an astonishing expansion both in fundamental facts and in important and far-reaching dogmas, and it is in this period that the student of to-day probably finds his chief interest. Dr. von Meyer has himself lived through it, and he writes with a full and accurate knowledge of its achievements, and in the spirit of detachment, of impartiality and insight which characterise the true historian. The work is a perfect treasure-house in its wealth of bibliographical and biographical detail. Its literary charm lies in the simplicity and directness of its style, characteristics which Dr. McGowan has well preserved in his admirable rendering into English. We commend the work to all students of chemistry in the certain conviction that they will rise from its perusal with their interest in the science—to use Ostwald's words again—vivified and deepened.

The work of Mr Armitage is of a different order, and, to the extent that it is original, is, we regret to say, a very immature production It shows few traces of independent inquiry, but is obviously based in large measure on that of von Meyer, and in general treatment follows that work pretty closely Now and again, however, Mr Armitage seeks to be original rather in mode of expression than in the compilation of facts, but he only succeeds in being obscure, and his attempts at epigram and "fine writing" usually end in bathos What, for example, is the precise meaning and value of the statement, "Even during that stage of transition which separated him from the brute creation, man must have appreciated the beneficial or harmful effect of many naturally occurring substances"? Quite true, no doubt, but the brute creation itself with equal certainty had this degree of appreciation of what was beneficial or harmful But Mr Armitage argues that in this appreciation we had the dawn of chemistry! What, too, is meant by saying that "Aristotle maintained the four elements earth air, fire and water" Of the philosopher's stone it is said, "But it was not till later that its full powers, transmuting and medicinal, obtained recognition" Considering that the philosopher's stone was a myth, could its full powers ever obtain recognition? Again, "the sulphurous smell observed on the calcination of tin was very cogent evidence of the presence of sulphur" Is it quite certain that there is a sulphurous odour when tin is calcined? What too is meant by saying, "Hoffmann's attitude was not, however, maintained by any attempt at practical verification and was moreover, devoid of the unifying intent of Stahl"? Of Priestley and Cavendish it is said, "Their outward circumstances were as diverse as their inner consciousness" This is said of Lavoisier —"The way of progress had been groped for long, the times were ripe for its discovery and Lavoisier was then chosen agent"

We further read of Lavoisier —"Complete success had awarded his efforts, and the weapons he had forged, of homage to experimental fact and scepticism of so-called established truths, were become the common property of scientific men"

Of Vauquelin we read —"His work on the separation of the rare metals platinum, palladium, rhodium iridium and osmium shows us how far the horizon had receded" The horizon must have receded very far indeed if it included indium in the time of Vauquelin It has hitherto been supposed that indium was not discovered until 1863

With respect to the attitude of Berzelius towards Dalton's hypothesis we read —"Berzelius, in reviewing the whole subject, became oppressed with the unscientific slapdash manner in which it has been approached by his contemporaries" This is precisely the feeling with which we review Mr Armitage's book, on reading it we too are oppressed with the unscientific slapdash manner in which the author has approached the whole subject of the history of chemistry

MONASTICISM.

Essays upon the History of Meaux Abbey and Some Principles of Mediaeval Land Tenure Based upon a Consideration of the Latin Chronicles of Meaux (A D 1150–1400) By Rev A Earle Pp 192 (Hull and London Brown and Sons, Ltd, 1906)

THE author of this volume is, we apprehend, a curate of Nafferton-with-Wansford, in Yorkshire, who, having obtained an exhibition at St John's College, Cambridge, for ecclesiastical history, has not neglected the subject in which he obtained distinction We welcome all such additions to the skeleton army of genuine students of antiquity, but Mr Earle has his spurs to win and his authority to establish, for it is not to be assumed that he learnt much about monastic chartularies and chronicles at Cambridge We make this preliminary remark because Mr Earle has not fortified his observations by marginal references to authority, he has written no preface, and has supplied no index We presume these essays are intended for his neighbours, and are the result of notes for lectures on the subject of an interesting abbey to the chapter of which the author's church belonged

The book is in two parts, the former containing eight chapters on the origin of the abbey and its influence on the surrounding country as imagined by the author, the latter containing six chapters on principles of land tenure The essays are stated to be based on "a consideration of the Latin Chronicles of Meaux, 1150–1400 and in the margins are placed dates which are references to volume and page of the Chronicles as published by the Record Office" We presume the Master of the Rolls' series is meant Having ascertained the scheme of the book we sought for a preface, in order to learn whether the author made an independent study of the chronicles and whether the observations and reasoning are his own But there is no preface, and we are thus unable to satisfy a reasonable curiosity The fact is that the Master of the Rolls published the chronicles of Melsa, or Meaux, in three large octavo volumes, 1866–8, the editor being Edward Bond, keeper of the manuscripts in the British Museum, and to each volume Mr Bond contributed a long and very learned preface Mr Earle ought surely to have explained whether his interesting narrative is or is not entirely derived from Mr Bond In the absence of such explanation we must presume that it is, and we regard the volume before us as an excellent abstract of three long treatises by a learned author We have, after much consideration, concluded that Mr Earle's work, easy of perusal and rather colloquial in style, presents a fairly accurate picture of human society in Holderness, as affected by one of many great institutions, religious in their origin, but commercial in practice

The abbey was founded by William le Gros, Earl of Albemarle, Lord of Holderness, in the year 1150, as the condition of being released from a vow to make a pilgrimage to Jerusalem The monk who influenced the earl was Adam, of the Cistercian Abbey of Fountains, who had much to do with the foundation of that

great house, and he obtained the Papal dispensation vacating the vow from Eugenius III, then living in France, according to this chronicle.

The abbey being established and possessed of a fair estate—the original wooden buildings replaced by stone—Mr. Earle attempts to describe the state of the surrounding country and inhabitants. Although he occasionally uses a doubtful expression, such as "the rich riding in carriages," his description seems to us good. But when the relations of the rich and poor are summarised in such words as the poor man "could not resist the Lord in the Lord's own Manor Court," the impression is produced that the author has made little study of ancient courts. The appalling results of the Black Death are well indicated, and the more this terrible period is examined the more exalted do the monks, nuns, and priests of England appear.

The essays on mediæval land tenure contain much debatable matter, and many statements which, without reference to authority, we cannot accept, as, for example, that the right to "common of pasture" could be alienated.

We have not space to discuss such questions, and must limit our concluding remarks to the fifth chapter. Here Mr. Earle states his views on the nature of bondmen, and cites the curious case of Adam, son of Ivo Grise, drawing the inference that the descendants of a bondman could at any distance of time be claimed by the heirs of the original lord. The facts stated are hardly sufficient to support so large an inference, but it certainly does seem that when the abbey acquired land from a "nativus" or his son it was thought desirable to complete the title by purchasing the claim of the lord.

It is not, of course, possible to treat with perfect accuracy an antiquarian subject within the limits of a small volume of less than two hundred pages, but we can commend Mr. Earle's essays to the general public, as they are well written with proper sympathy with an old order now for ever passed away.

THE PLANTS OF KUMAON.

Catalogue of the Plants of Kumaon and of the Adjacent Portions of Garhwal and Tibet. By Lieut.-General Sir Richard Strachey, G.C.S.I., &c., revised and supplemented by J. F. Duthie. Pp. vii+271. (London: Lovell Reeve and Co., Ltd., 1906.)

THIS catalogue is based on the collections made between the years 1846 and 1849, in the province of Kumaon and the adjoining parts of Garhwal and Tibet by Lieut. (now Sir Richard) Strachey and Mr. J. E. Winterbottom. The collection was principally made along a line extending through the province of Kumaon across the Himalaya in a south-westerly to north-easterly direction, over a distance of eighty or ninety miles from the plain of Rohilkhand at about 1000 feet above sea-level, to the Tibetan plateau at an altitude of 14,000 feet to 15,000 feet on the upper course of the River Sutlej. The collection, generally known as the Strachey and Winterbottom Herbarium, included more than 2000 species, and sets of the plants were presented more than fifty years ago to the important herbaria in this country and abroad, together with a provisional catalogue. The present catalogue includes, besides the species represented in the original Strachey and Winterbottom herbarium, the results of previous and subsequent botanical exploration of the area from the time of Wallich, Royle, Falconer, Thomson, and others, up to a comparatively recent period. Among the more important recent contributions to our knowledge of the Kumaon flora are the large collection made by the late Colonel Anderson, chiefly in the vicinity of Naini Tal, and the results of the extensive botanical explorations made by Mr. Duthie during his term of residence as Government botanist in the North-West Provinces.

Including a small number of cryptogams, the flora of Kumaon, as represented in the catalogue, contains 3043 species, representing 1084 genera. No fungi or algæ are included, and only fifty genera of lichens, hence much remains to be done to give an adequate idea of the flora so far as cellular cryptogams are concerned. On the other hand, we may regard the representation of the flowering plants as fairly complete. Mr. Duthie makes a comparison with the flora of China on the one hand and of Britain on the other. Of the 137 natural orders of flowering plants represented in Kumaon, 134 are found in China and 84 in Britain; of the 983 Kumaon genera, 812 occur in China and 287 in Britain, and of the 2073 Kumaon species, 1070 are Chinese and 226 British. The most predominant order in the area concerned, as estimated by number of species, is Gramineæ (226 species), followed by Compositæ (211 species), Leguminosæ (204 species), and Orchideæ (161 species). In the Eastern Himalaya and in British India as a whole Orchideæ occupy the first place, with Gramineæ and Leguminosæ taking the second and third and third and second places respectively in the two areas concerned, while Compositæ stands fourth in the Eastern Himalayas, and seventh in the whole of British India. For the whole world Compositæ stands first, Leguminosæ second, Orchideæ third, and Gramineæ fifth.

The arrangement of the orders, genera, and species of the flowering plants is in accordance with that adopted in the "Flora of British India." The ferns were named and arranged by the late Mr. C. W. Hope, and the Bryophyta by Mr. C. H. Wright, following the plan adopted by Mr. Mitten in 1859. The method of the catalogue is a tabular one; for each species or variety, there are indicated in a series of parallel columns the habit of growth, colour of flower, time of flowering, locality, elevation, and occurrence respectively in the Himalayas (rainy or dry), Tibet, China and Britain. The book as a whole forms a remarkably clear and concise review of the flora of an eminently interesting district of the Western Himalayas. A useful appendix is given in the form of a list comprising the determinations of the numbers in the Strachey and Winterbottom Herbarium according to the original catalogue and their equivalents in the present volume. Some of the changes are due to alterations of nomenclature, others to a more thorough investigation of the plants.

A. B. R.

ENGINEERING DESIGN AND DRAWING

(1) *Machine Design* By Prof Albert W Smith and G H Marx Pp viii+369 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1905) Price 12s 6d net

(2) *Elements of Mechanical Drawing* By A A Titsworth Pp v+130 (New York John Wiley and Sons, London Chapman and Hall Ltd, 1906) Price 5s 6d net

(1) THE authors of this text book have wisely departed somewhat from the usual practice followed in books on machine design, and have devoted the first five chapters to discussions of the general principles of kinematics which underlie the design of all classes of machinery These chapters, in fact, deal with subjects such as constrainment of motion, relative motion, linkages, linear and angular velocity diagrams &c, which the student usually finds only fully and clearly discussed in such works as Kennedy's "Mechanics of Machinery" In the sixth chapter the question of the proportions of machine parts as dictated by stress is taken up, and rules are given for the working stresses which must be adopted under any given set of conditions

Fastenings, including rivets and bolts and nuts are then considered The authors rightly point out that the dimensions of the rivets which would be necessary in order to secure a joint of absolutely uniform strength are, in the case of lap joints, usually too large for practical convenience, and that, therefore, a compromise has to be effected, but surely the tables on pp 94 and 95 are carried to an excess as regards thickness of plates as no one would in practice think of using such joints for plates one inch or more in thickness In dealing with bolts and nuts naturally only the United States standard threads are employed and in this chapter the results of some interesting experiments on the design of bolts for shock are given, it was shown that bolts with a hole drilled out in the centre through the unscrewed part so as to give them a uniform cross sectional area from end to end were much stronger against shock than the original solid bolts

The design of axles and shafts and of their bearings, including the modern ball and roller bearings, is very fully treated in several chapters, and then follow details of the design of couplings both permanent and frictional, and a complete explanation of the theory of the transmission of power by belts and of the necessary calculations in order to settle the dimensions of belt required in any given case

Fly-wheels and toothed wheel gearing are taken up in the next two chapters, the proper shape of gear teeth and their strength being dealt with in a very thorough manner In the concluding chapter a branch of machine design usually much neglected in text-books is discussed, namely, the proportions and best shapes for machine frames

The authors are to be congratulated on the fact that they have avoided crowding their illustrations with minute details, and, as a result, all the figures are clear, and the important points in the design which they are intended to illustrate are easily followed The book should prove a useful text-book for engineering students in their first and second years' courses in machine design

(2) This book is divided into two parts In the first part, for beginners the various drawing instruments in common use are described, and a series of exercises is given to illustrate the use of each of the instruments The rest of this section is devoted to examples in simple projection, to intersections of solids, and development of surfaces Part ii, for more advanced students comprises problems in descriptive geometry, isometric projection oblique projection, shadows and perspective work, and concludes with a series of problems The author has dealt with a branch of engineering drawing which is more commonly denoted by the name of geometrical drawing The volume will form a useful text-book for students in engineering colleges during the first year of their course

T H B

OUR BOOK SHELF

Das Kloster Kumbum in Tibet By Wilhelm Filchner Pp xi+164, with maps, plans and numerous plates (Berlin S Mittler und Sohn, 1906) Price 8 marks

ONE of the most popular fanes of Lamaist pilgrimage is the great golden roofed temple of Kumbum, about half-way between Lhasa and Pekin in the neighbourhood of the Koko Nor Lake, on the border of Mongolia It marks the sacred spot where was born in 1356 A D the reforming Lama and canonised saint Tsong Khapa who founded the now predominant yellow cap sect which wields the temporal power On the sacred spot itself within the precincts of the temple, stands an old tree which is believed to have sprung miraculously from one of the saint's hairs It is locally known as the "white sandalwood tree" and both its leaves and bark are held in great veneration as exhibiting on their surface images of the holy man M Huc, in his lively description of his visit to this sanctuary and his interview with its "Living Buddha," half a century ago, declared that he himself saw the images on the leaves, and he attributed this extraordinary phenomenon to the devilry of the priests Since Huc's time the place has been many times visited and described by Europeans lying as it does within that portion of eastern Tibet which has been annexed by China and thus much more easily accessible than the "Forbidden Land" of the Lhasa Lamas

By far the best and fullest of these descriptions has hitherto been that by Mr Rockhill the present United States Ambassador at Pekin Mr Rockhill found that the alleged images on the leaves and bark were a delusion, and that they only appeared to those votaries who had firm belief whilst the faithless could distinguish nothing extraordinary on them The specimens of the leaves and bark collected by Mr Rockhill were identified by Mr Hemsley, of Kew, as those of *Syringa villosa* Vahl, whilst Dr Kanitz, of St Petersburg, made the tree out to be ***Ligustrina amurensis*** (NATURE, April, 1896, pp 534 and 556) Lieut Filchner now gives us a handsome monograph on Kumbum, its temple, tree, and priests, as the result of his expedition there in 1903–1905, by way of Shanghai Mr Filchner started commendably equipped with an intimate knowledge of the literature of his subject, and has produced a record of permanent value, embodying a good deal of new re

search about the temple and its large monastery of nearly 4000 priests. He devotes several pages to the sacred tree, which has been identified for him as *Syringa Giraldiana*, K. Schneider. A word of praise is due for the excellent illustrations, many of them from photographs by Frau Filchner, who accompanied her husband in his travels. Altogether the book forms a complete guide to the place, and is admirably produced at such a marvellously cheap price as is only possible on the Continent. I. A. WADDELL.

A Century's Progress in Astronomy. By Hector Macpherson, jun. Pp. xi+246. (London: W. Blackwood and Sons, 1906.) Price 6s. net.

IN attempting to crowd an account of a century's progress in one of the most progressive of sciences (during the last century) into 238 pages of well-displayed print we fear that Mr. Macpherson has attempted too much in too little space. The volume will certainly be found useful for reference as an astronomical "Who's Who," but we fear that the general reader will have but a hazy idea of the true meaning of the century's progress after perusing it.

The first two chapters, occupying more than one-sixth of the total reading matter, deal with Herschel the "pioneer" and "discoverer," and are full of interest and information. The subsequent chapters (iii. to ix.) treat of the celestial bodies in the conventional order, and as completely as can be expected in so confined a space the more important discoveries, e.g. those by Schwabe, Janssen, Lockyer, Fuchini and others concerning the sun, receiving a fair amount of attention.

The concluding chapters (x. to xiv.) deal with the spectroscopic and variable-star work, stellar systems, stellar distribution, and celestial evolution, the various theories and researches in each branch being passed in rapid review.

Speaking generally, Mr. Macpherson's information is up to date, and includes most of the events in the century's work, but in some few cases this is not so. For example, we are surprised to find that although the names of some dozen foreign double-star observers are given (p. 201) no English name has been found worthy of inclusion, not even that of Thomas Lewis. Again we believe that Sir Norman Lockyer's later researches have, by a natural order of progress, advanced his temperature classification beyond the stage where the Sirian stars were thought to illustrate the acme of temperature. A bibliography giving references to the original works so briefly epitomised in this volume would be of great value, but the book contains no references. W. J. R.

The World's Calendar. Invented by the Rev. J. P. Wiles. (London: G. Philip and Son.) Price 2s. net.

MR. WILES has devised a very ingenious toy which will exhibit the day of the week corresponding to any calendar date, and also Easter-day for any year.

We do not think that any better mechanical method could have been constructed, but we are not much in sympathy with contriving any device of the kind. The information given is not often required by most of us, and those who do require it had far better work from a concise tabular statement.

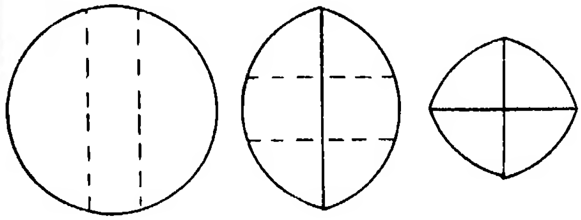
As a Christmas present it would probably give satisfaction. Perhaps Mr. Wiles contemplated this in bringing his calendar out in November. From this point of view it deserves success, and will prompt the curiosity of some to try thoroughly to understand the construction.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Cutting a Round Cake on Scientific Principles.

CHRISTMAS suggests cakes, and these the wish on my part to describe a method of cutting them that I have recently devised to my own amusement and satisfaction. The problem to be solved was, "given a round tea-cake of some 5 inches across, and two persons of moderate appetite to eat it, in what way should it be cut so as to leave a minimum of exposed surface to become dry?" The ordinary method of cutting out a wedge is very faulty in this respect. The results to be aimed at are so to cut the cake that the remaining portions shall fit together. Consequently the chords (or the arcs) of the circumferences



Broken straight lines show intended cut. Ordinary straight lines show the cuts that have been made. The segments are kept in apposition by a common elastic band that encloses the whole. In the above figures about one third of the area of the original disc is removed by each of the two successive operations.

of these portions must be equal. The direction of the first two vertical planes of section is unimportant; they may be parallel, as in the first figure, or they may enclose a wedge. The cuts shown on the figures represent those made with the intention of letting the cake last for three days, each successive operation having removed about one third of the area of the original disc. A common india-rubber band embraces the whole and keeps its segments together. F. G.

Anode Rays.

IN the *Deutsch. Phys. Gesell.* (Verh. 8, 21, pp. 559–566, November 15) there appears a paper by Gehrcke and Reichenheim under the title of "Anode Rays."

By means of a special construction a discharge is sent through a tube in which the anode consists of an inorganic salt placed on platinum foil and heated to a dull red heat by an auxiliary current. The salts used are mostly chlorides. In these circumstances a brilliant bundle of coloured rays is emitted by the anode, but this emission soon ceases. These rays the authors call "anode rays." Their positive charge is demonstrated by shooting them into a Faraday cylinder and by their magnetic deflection. These results appear to me to be attributable to the emission of positive ions by heated salts, which has already been investigated by Mr. Garrett and myself (*Phil. Mag.*, October, 1904). Mr. Garrett has continued the work described there, and finds that most haloid salts behave in a similar manner, and that this positive emission can readily be detected at ordinary temperatures. Both the number and velocity of the ions increase rapidly as the temperature is raised or pressure lowered, and in the paper mentioned we found that the emission ceased when the heating was continued. Allowing for the difference in temperature, Gehrcke and Reichenheim's results and ours appear to be different aspects of the same phenomenon. We are now seeking to determine what exactly the positive ions are, and in this connection the observation is of interest that the anode rays give very sharp lines of the metal involved when coupled with J. Stark's discovery that the canal rays are the emitters of the hydrogen line spectrum. R. S. WILLOWS.

Cass Institute, E.C., December 17.

THE DEVELOPMENT OF MODERN ARTILLERY AND EXPLOSIVES[1]

THIS volume is a re-publication of the many valuable papers and lectures which Sir Andrew Noble has contributed on the subject of artillery and explosives. Everyone recognises that there is no greater authority on these subjects than the author, and certainly the marvellous development of heavy weapons within the last forty years would have been impossible but for the solid scientific foundations which Noble and his colleagues laid down. His has been a career of activity almost unequalled, his investigations extending from the period when he was secretary to the first Committee on Rifled Cannon (1858) down to the present time, when Sir Andrew Noble still serves on the Ordnance Research Board, and only last year contributed further valuable papers on the combustion of certain smokeless powders.

As illustrating the development in gun construction which has taken place during this period, it may be mentioned that the heaviest gun in use when Sir Andrew first joined the service was a cast-iron weapon weighing 95 cwt. and firing a round shot of 68 lb. weight with a muzzle velocity of 1600 feet per second. A comparison of this with the enormous velocities, energy and range of modern weapons such as form the heavy armament of our present-day battleships clearly shows that these advances could only have been made as the result of careful scientific experiment. Noble, together with his colleague the late Sir Frederick Abel, will ever be associated as the leading minds in this magnificent experimental work.

The apology which the author makes for this re-publication is therefore quite unnecessary, and all interested in the subject will gladly welcome this volume, for the papers and lectures were delivered before such various societies that it is often difficult to obtain access to the whole of them. Necessarily there arises a certain amount of repetition, but, as pointed out, the elimination of this would practically have meant re-writing the work, so that the papers appear precisely in their original form. Not only will the collection of them prove of value to the technical man, but several will appeal to the general reader, notably those on "The Rise and Progress of Rifled Naval Artillery" and "Mechanical Science in Relation to the Naval and Military Services."

The preface alone is most interesting, and might well be quoted at length. Two points only, however, which throw light on the objection to any change in the old days, may be noted. After the introduction of rifled artillery, a dinner was given by the Royal Artillery mess to the late Lord Armstrong. After eulogising the work done by the guest of the evening, the president concluded with the emphatic statement, "for myself I am radically opposed to any change." Again later, when Artillery officers were pressing for the introduction of a naval gun weighing seven tons, the naval officers "doubted whether so heavy a gun could be carried on board ship," and a compromise was effected by introducing a gun of 6½ tons. Yet we have had vessels, the *Sans Pareil* and *Benbow* (both long since obsolete), carrying two 110-ton guns!

[1] "Artillery and Explosives." By Sir Andrew Noble, Bart., K.C.B., F.R.S., &c. Pp. xvi+548. (London: John Murray, 1906.) Price 21s. net.

The first paper deals with the "Application of the Theory of Probabilities to Artillery Practice," and afforded valuable information as to the superiority of rifled ordnance. The paper is a mathematical one based on actual firing results, the object being to determine "for each gun, that area within which, if a given number of shots were fired, half of the number might be expected to fall." This paper is followed by one on "Experiments with Navez's Electroballistic Apparatus." Other papers of similar type are those "On the Ratio between the Forces tending to produce Translation and Rotation in the Bores of Rifled Guns" and "On the Pressures required to give Rotation to Rifled Projectiles," in which the relative behaviour with uniform and parabolic rifling is critically examined.

To the man of science, as distinct from the artillerist, undoubtedly the researches on the changes taking place during combustion of explosives, the measurement of temperatures, pressures, and velocities will be of the greatest interest. These researches may be said to commence with a paper "On the Tension of Fired Gunpowder" (1871), although part i. of the now classical "Researches on Explosives" did not appear until 1875. As already mentioned, only last year a

EXPLOSION VESSEL

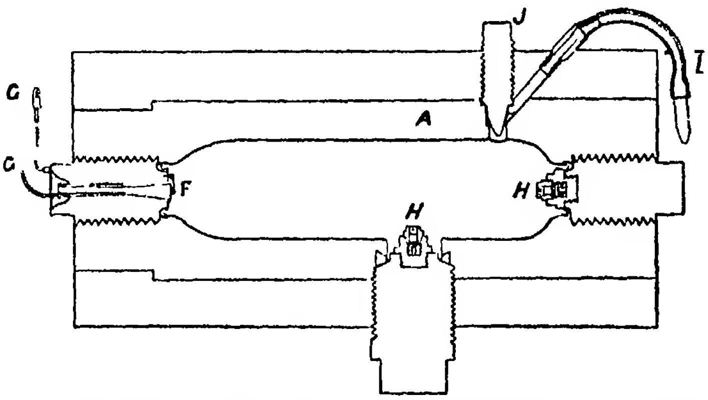


FIG. 1.—Vessel employed for small charges, to enable the gaseous products to be collected and examined. The firing plug is shown at I; the crusher gauges for determining the pressure at H, H; the escape valve for the gases at J.

further contribution under this title was published in the Proceedings of the Royal Society (followed later by a note making certain corrections on temperature estimations), which greatly extended our knowledge on the variation in the products, temperature, &c., when certain modern smokeless powders are fired under varying conditions. It is one of the few points on which we may offer criticism that these two papers are not included in the present volume, and unless some restrictions as to re-publication prevented, it is difficult to understand why they were omitted, for they are certainly not the least valuable of the series.

When Noble and Abel first took up the examination of gunpowder, the knowledge on the subject was simply chaotic. Owing to faulty methods, unjustifiable assumptions, and other causes, the most diverse ideas as to the pressure and temperature developed on firing were held. Rodman, with his well-known "cutter gauge," had done valuable work, but here, as shown in an early paper in this volume, error arose from inertia of the cutter employed. For the examination of the products on firing charges occupying but a small portion of the space in the experi-

mental vessel had been employed Sir Andrew Noble and his colleagues fully appreciated the necessity of examining the products when the powder was fired as nearly as possible under like conditions to those existing in the gun, and it was not until they succeeded in retaining all the products when the charge was fired in a space which it completely filled that knowledge on the changes commenced to have any claim to scientific accuracy Charges so large as 23 lb of gunpowder and 5 lb of guncotton have been fired in the author s explosion vessels, illustrations of which we reproduce

We have become familiar with combustions under these conditions, but it is not difficult to appreciate the risks and troubles incidental to such work, and the patience required by the pioneers to overcome these difficulties Interesting references will be found to some of these troubles in more than one paper An account of one singular accident may be quoted --

' The end of the vessel was placed against a wrought iron beam The screw- a half-inch pitch being a very good fit was screwed into its place with much difficulty and with the use of a good deal of oil On firing, the screw unscrewed until the last two threads were reached These were sheared Owing to the wrought-iron beam there was no motion of translation, but the motion of rotation was so high, that the screw first striking the ground and then an iron plate at an angle of 45°, went vertically into the air with a singular humming noise, descending in about 30 seconds a few feet from the place whence it rose "

Only two points need be mentioned in connection with the researches on gunpowder The author adopting and relying on Bunsen and Schischkoff's method for estimating hyposulphites in the residues regarded potassium hyposulphite as being formed as a primary product during combustion, a conclusion questioned by Berthelot, who regarded it "entirely as a product formed during the collection and analytical treatment of the solid residue " In a controversy which followed Noble made out a good case for supposing no change to have been possible during the preparation of the material but appears not to have considered the other possibility, faulty analytical methods Later Debus showed that this was the case and that actually the treatment produced hyposulphite, which necessitated a re-calculation of the composition of the residues Attention might have been directed to this earlier in the book

No practical method is available for determining the actual temperature of explosion but making certain justifiable assumptions, calculated temperatures of approximate accuracy may be obtained With Service gunpowder the author concluded the temperature to be about 2200° C , and regarded the signs of fusion of pieces of platinum in the charge as confirming this, Deville's value of "nearly 2000° C " being taken as the melting point of platinum Holborn and Wein have more recently shown the melting point to be close to 1780° C , so that possibly the temperatures for gunpowder are somewhat high

It may be noted that as a direct result of the researches on gunpowder, guns were constructed which advanced the velocities from 1600 to 2100 feet per second

Although gunpowder held its own for centuries with but slight modification, it has now become a thing of the past as a military propellant explosive The advantages of a smokeless powder are so great that as soon as the difficulty of "taming" guncotton had been overcome, its adoption, either gelatinised alone or mixed with nitroglycerin quickly followed Again Noble and Abel were pioneers in our knowledge of the conditions attending the use of smokeless powders Naturally the very full and lucid accounts of the large number of experiments made by Sir Andrew Noble and his colleagues will prove of even greater interest than the earlier work on gunpowder Throughout they enjoyed enviable facilities for actual trials in large experimental guns with full charges and so were enabled to correlate the values in practice with laboratory experiments

EXPLOSION VESSEL

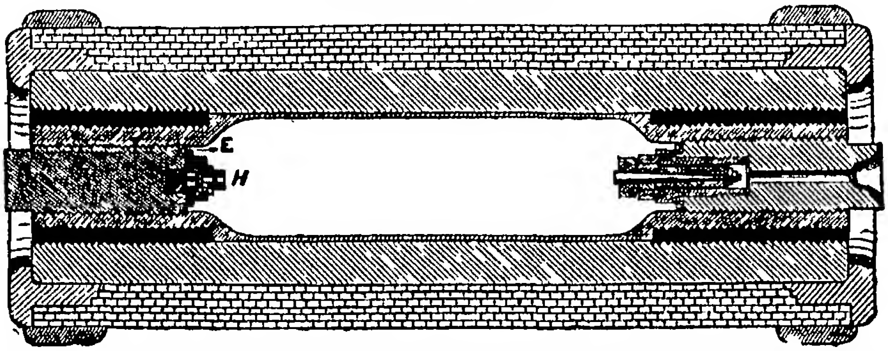


FIG 2 —Vessel employed for heavy charges Crusher gauge is shown at H the firing plug being situated at the opposite end The shell proper was strengthened by being wound with steel tape

The changes involved during the combustion of smokeless explosives are less complicated than with gunpowder Conditions, however, greatly modify the proportions in which the various permanent gases are found hence the total gas volume is also affected The influence of increasing amounts of nitroglycerin to nitrocellulose in cordites was first fully worked out by Noble and has proved of the greatest practical value since it has a close connection with the important question of erosion With the introduction of the old form of cordite for large guns, the loss of accuracy and short life of the gun became serious matters for consideration Noble showed erosion to be due to two causes, (*a*) high temperature of the products, (*b*) the motion of these hot gases Further, a series of elaborate experiments with specially prepared cordites containing increasing percentages of nitroglycerin showed that increase of temperature went hand in hand with increase of nitroglycerin, and consequently also the erosion

The logical step therefore, was to reduce the percentage of nitroglycerin and, as is now common knowledge the new M D cordite contains only 30 per cent of nitroglycerin instead of 58 per cent as in the earlier form Powder of this composition will for the same charge and size of cord, give less energy in the gun, but this may be overcome by suitable modification of the charge and size of cord These points are all made beautifully clear by some excellent coloured plates in the last paper which was delivered in 1900 at the Royal Institution Other instructive plates in the same paper are those dealing with velocities and pressures derived from them in

a series of experiments with numerous modern smokeless powders, carried out in a 100-calibre 6-inch gun

We still employ M D cordite in spite of the almost universal adoption by our European neighbours and the Americans of simple nitrocellulose powders, which they experience considerable trouble in keeping in a stable condition, and we may therefore assume that no great advance has been made since Noble's experiments clearly indicated the right path to be followed in the production of a trustworthy smokeless powder which shall give minimum erosion, whilst possessing the essential quality of stability

I S S B

A HALF-DOZEN ILLUSTRATED NATURE BOOKS[1]

If the lover of natural history and country life whose tastes incline to the study of the higher animals and who may also possess an appetite for a spice of philosophy, cannot find matter to his liking in at least one of this excellent half dozen of popular books he must indeed be hard to please The first five are charming examples of the modern style of nature-study and popular natural history works, and the general excellence of the style of the text is only equalled (or shall we say surpassed?) by the exquisite illustrations Since each volume has a special line of its own we are fortunately spared the invidious task of deciding as to their comparative merits

The first volume in the list the forerunner apparently, of a series of volumes written on the same general lines is a natural history of mammals, in which while the group is taken in systematic order, the method of treatment is so popular (and at the same time so accurate) that it can scarcely fail to appeal to a very large series of readers many of whom will be glad to find it unencumbered as a rule with scientific names The great feature of Mr Ingersoll's book is, however, formed by the illustrations many of which more especially the coloured plates and the reproductions from photographs are beyond praise Among the best may be reckoned several of the twelve coloured plates drawn by the author's daughter Those of the fallow-deer and the jaguar are reproductions from German works, and in the case of these as well as in that of the water chevrotain on p 342 which is copied from an encyclopædia article by Sir W H Flower, we fail to notice any acknowledgment of the source Special attention may be directed to the photo of the Himalayan tahr on p 262 as showing the shaggy character of the coat which is so completely lost in all museum specimens we have seen On the other hand it may be noticed that on p 240 the author gives a figure of the head of an African buffalo to do duty for that of the Indian wild ox or gaur, while the cut of an urial's head on p 251 is a ludicrous caricature

In general the text is well up to date, including, for instance an account of the pedigree of the elephant, but it is rather behindhand in the matter of giraffes, and likewise in classing all antelopes as members of a single subfamily Moreover, in definitely asserting that the latter animals are recent immigrants into Africa the author ignores the recent suggestion of Mr Madison Grant as to the Bovidæ being an endemic Ethiopian group As instances of error we may refer to an evident mistake in regard to the colour of Pembroke cattle (p 240), and to the reference of the name "ravine-deer" to the blackbuck (p 277) These are, however but trifling slips, and scarcely detract from the general excellence of a most attractive volume

A Christmas bird book from the pen and camera of Mr Kearton is a standing dish to which all young bird-lovers look forward with delight and we can

Fig 1 —Chiffchaff and Nest From Nature's Carol Singers

assure them that they will not be disappointed at the fare their favourite author and artist has provided for the present season This time Mr Kearton has taken up his subject from a more definitely systematic point of view than usual dealing "in a concise and popular manner with the appearance, haunts habits nests, eggs, songs, and call notes of the winged melodists that breed in various parts of the British Islands I have endeavoured" he continues "to describe them in such a way that the reader may be able to identify them for himself or herself in wood and field, and where two species bear a similarity of appearance or song to emphasise the points wherein they differ"

In this aim the author appears to have been successful condensing the necessary technical descriptions

[1] (1) The Life of Animals—the Mammal By E Ingersoll Pp xi+555 illustrated (New York The Macmillan Co London Macmillan and Co Ltd) Price 1s 6d net

(2) Nature's Carol Singers By R Kearton Pp 251 illustrated London Cassell and Co Ltd) Price 6s

(3) An Idler in the Wilds By T Edwardes Pp viii+109 illustrated (London John Murray) Price 6s net

(4) I Go A Walking through the Woods and o'er the Moor Compiled from the works of the late Rev C A Johns and others Pp 79 illustrated (Edinburgh and London T N Foulis) Price 2s 6d net

(5) "Brier Patch Philosophy" By Peter Rabbit Interpreted by W J Long Pp xvii+96 illustrated (London Ginn and Co) Price 6s net

(6) "Birds Shown to the Children" By M K C Scott described by J A Henderson Pp 112 illustrated (London and Edinburgh T C and E F Jack) Price 2s 6d net

of colouring into as small a space as possible, and afterwards elaborating the more interesting details of habits and distribution As in all Mr Kearton's books, the great attraction is however the illustrations, which are from photographs by himself and his brother, and in this volume, were we not afraid of libelling their earlier efforts, we should be tempted to say that the artists have surpassed themselves Be this as it may the charming illustrations in this volume would be hard to beat as our readers may judge for themselves from the sample here reproduced (Fig 1) which was selected almost at random, as where all are excellent it is difficult to make a choice A more attractive gift book for young people fond of birds—as all of them should be and probably are when they have the proper opportunities would be difficult to find

The third volume in the list is, as implied by its title less of a purely natural history than either of the two preceding ones dealing largely with country scenery and country life, the frontispiece depicts a beautiful scene from an old-fashioned English hamlet with thatched cottages, while other illustrations show no less exquisite glimpses of shore and river landscape Certain chapters, such as the one on the flight of the swift and another on the song of the skylark, are however vivid sketches of phases in the habits and life history of birds possessing a peculiar interest and charm of their own, and it is only lack of space that prevents our dwelling on these at some length Both those mentioned are illustrated with photographs of the species to which they are respectively devoted, and many readers will be specially interested in the author's observations with regard to the nocturnal flight of the swift In saying that Mr Tickner Edwardes's little volume although written on different lines, vies in interest with Sir Herbert Maxwell's "Memories of the Months" we are bestowing a very high meed of praise

"I Go A-Walking," which is dated 1907 although it was previously issued in parts and the first of these noted in our columns on its first appearance is a series of brief illustrated biographies of certain selected birds and animals These are no doubt excellent in their way but the charm of the book lies in the illustrations, and since these are reproductions from photographs by Mr C Reid of Wishaw it would be waste of words to add anything in the way of commendation A special feature of the work is the number of illustrations of groups of young birds, and that our readers may judge for themselves as to the excellence of these (and the illustrations generally) we reproduce, by the courtesy of the publisher, one showing a trio of young rooks

FIG 2 —Young Rooks From "I Go A Walking

The fifth book on our list is on a higher plane and of a type totally different from any of the others, dealing mainly with animal psychology, and revealing the thoughtful and speculative mind of the talented author To do justice to Mr Long's ideas and theories in the space of a few lines is a manifest impossibility, and we must be content to refer to his belief that the lower animals "possess a rudimentary mind" and may therefore be accorded "some small chance for immortality" With these sentiments we have no cavil, but when we read the statement that "death to the animal is but a sleep, and the only thought in his head when he lies down for the last time is nature's whisper that he will waken as usual when the right time comes" we would ask the author how many wild animals die so to speak, in their beds? With this brief notice we must leave (and commend) a thoughtful work to the best attention of earnest and thoughtful readers

Last and likewise least is the little volume on birds in Miss Chisholm's "Shown to the Children" series In works of this nature the necessity for abundant illustration overrides all other considerations and if in this instance quantity somewhat exceeds quality it must be borne in mind that forty eight full-page coloured plates form a very liberal allowance in a half-crown book and that the style of execution will probably pass muster among the readers of the book If we except a few sentences such as the statement that blackbirds eat snails the letterpress appears in the main to be just what should be provided for very juvenile readers R L

THE TREATMENT OF CANCER

IT is an appropriate coincidence that the sensational statements made in the daily Press last week respecting the cure of cancer should have as their antidote the scientific discourse "On the Treatment of Cancer by Modern Methods" which was delivered at the Royal College of Surgeons, as the Bradshaw lecture by Mr Edmund Owen on December 12 In an article in the *Pall Mall Gazette* Dr Saleeby went so far as to assert that the conquest of cancer is within measurable distance the means of cure being trypsin a digestive ferment formed by the pancreas and passed in its secretion into the duodenum the upper part of the small intestine

The use of trypsin as a cure for cancer seems to have suggested itself independently to two observers Mr J Beard and Dr Shaw-Mackenzie the former apparently on embryological grounds and the latter because of the comparative immunity of the small intestine from cancer Thus in 105,574 cases of cancer of the digestive tract the small intestine was affected in only twenty [1] Beard found that in mice the subjects of experimental cancer (the Jensen

[1] Shaw Mackenzie [illegible]

tumour), injections of trypsin caused shrinkage and degeneration of the tumours[1] a not unlikely event considering the active digestive properties of trypsin, and his method is stated to have been carried out with success in the human subject by Prof Morton in America

The full report of the work of Prof Morton will be awaited with interest, but, in the meantime, the premature publication of details cannot be too strongly condemned It is well known that trypsin has been tried in this country by many without any startling success, it is possible that it may be valuable in certain localised growths, just as radium and the X-rays are in selected cases, but, on the data available to assert that the conquest of cancer is near at hand is unreasonable and does infinite mischief to science as well as increasing the suffering of the unfortunate victims of this dire malady by hopes that are destined not to be realised

With reference to Mr Beard's experiments on mouse cancer it is to be noted that this so-called experimental cancer is an implantation of the disease into an animal, and not a cancerous metamorphosis of the animal's own tissues a thing very different from spontaneous cancer Chian turpentine violet leaves, Doyen's serum, and a host of other remedies have all at some time or other been vaunted as specifics for cancer, but none has stood the test of rigorous trial

In conclusion an extract from the Bradshaw lecture may be quoted —

"Surgery must not go in advance of facts, or she will assuredly be overtaken and tripped up as she has learnt from sad experience At present it is beyond her power to promise to *cure* cancer, whether by a cutting operation, by X-rays, by Finsen's light, or by any drug or nostrum injected into the blood, taken internally or applied locally Treatment is unfortunately not the same thing as cure, and the most effectual treatment for cancer—no matter how small it may be—is still removal by the knife "[2]

NUBIAN ANTIQUITIES

AN important philological discovery is announced from Berlin Profs Karl Schmidt and H Schäfer who are well known for their work in connection with Coptic literature and Nubian antiquities respectively, have succeeded in making out something of the meaning of some religious documents of the eighth century A D, written in Coptic characters, but in the Nubian language The three Nubian dialects of to-day Kenûs, Mahass, and Danâkil, are not written We have, of course, considerable knowledge of the grammar, &c, of these modern dialects, but of the earlier history of the language but little is known Hence the interest of Prof Schmidt's discovery If the two savants concerned succeed in making out more of the language, we may be able to decipher some of the *few* Nubian inscriptions written in Coptic characters which still exist

In the description of the rock-cut grottoes of Gebel Adda, near Abu Simbel, in Murray's "Handbook for Egypt" (1896, p 977), we find the following passage—"On the walls are some Coptic inscriptions, and on the S wall of the adytum is a long text of 14 lines, in what Lepsius calls 'Christian Ethiopic,' of which another example exists on a rock (now partly broken) at the foot of the cliff on which Qasr Ibrim stands The letters are those of the Coptic alphabet, but the language is unknown" This is the kind of inscription referred to Such records are very rare, and we fear that even when read they will prove to be of religious character, and will not throw the "light on the history of the earliest Nubian races" which the sanguine Berlin correspondent of the *Globe* (December 11) anticipates The discovery referred to is published in the *Abhandlungen* of the Royal Prussian Academy of Sciences under the title "First Fragments of Christian Literature in the Old-Nubian Language"

The Old-Nubian inscriptions of Qasr Ibrim and Gebel Adda are not referred to in Prof Breasted's recently published report on the "Temples of Lower Nubia" (Chicago, 1906) We hope they have not suffered of late years With regard to the grottoes of Gebel Adda, we note that on p 18 of his report Prof Breasted claims to have discovered a fact that has in reality been known for at least ten years, namely, that the ancient Egyptian Viceroy of Nubia, Paser, who cut a "memorial niche" for himself in this rock lived in the reign of Eye (Ai) as well as in that of Harmhab (Horemheb) Prof Breasted errs in his statement that Paser was "heretofore [? hitherto *heretofore* can only refer to matter comprised in Prof Breasted's previous pages] supposed to have been in office only under Harmhab" He will find the fact noted in the 1896 edition of Murray's "Egypt" probably by that indefatigable collector of Egyptian epigraphic material Prof Sayce

Murray's book is especially useful for rock-tombs and inscriptions and has far more detail of sites not usually visited by tourists than Baedeker has, but Prof Breasted has religiously followed his German guide and so has fallen into Baedeker's error of calling the temple of Serret el-Gharb, south of Gebel Adda "the temple of Aksheh" (p 17) This mistake was pointed out by Prof Sayce in the "Recueil de Travaux" for 1895 but still remains uncorrected Aksheh Aksha or Akasheh is many miles away south of Wadi Halfa, there is a village called *Eshka* however, not far off which may be the origin of Baedeker's mistake

[1] *Brit Med Journ* 1906, i p 140
[2] *Brit Med Journ*, 1906 ii, p 1601

NOTES

THE following presidents of sections have accepted office for the meeting of the British Association to be held at Leicester next year —A (Mathematics and Physics), Prof A E H Love, F R S, B (Chemistry), Prof A Smithells, F R S, C (Geology), Prof J W Gregory F R S, D (Zoology), Dr W F Hoyle, E (Geography), Mr George G Chisholm, F (Economics), Prof W J Ashley, G (Engineering), Prof Silvanus P Thompson, F R S, H (Anthropology) Mr D G Hogarth, I (Physiology), Dr A D Waller, F R S, K (Botany), Prof J B Farmer, F R S, and L (Educational Science), Sir Philip Magnus M P

THE Royal Irish Academy held a very successful conversazione in the Academy House on December 4 Their Excellencies the Lord Lieutenant (visitor of the academy) and the Countess of Aberdeen were present and a large and distinguished company accepted the invitation of the president and council Some of the rare manuscripts in the possession of the academy were on exhibition, and attracted much attention, and interesting demonstrations were given in connection with recent scientific developments There were shown by the fisheries branch of the Department of Agriculture and Technical Instruction for Ireland a number of important additions to the marine fauna of Ireland Some new scientific instruments were

exhibited and explained, and there was a notable series of large photographs of Vesuvius taken during the recent eruption

IN the speech of the Secretary for Scotland on December 14, during the debate in committee of the House of Commons on the National Galleries of Scotland Bill the following passage describes his final proposals regarding the accommodation and grant to the Royal Society of Edinburgh —" He had now to mention the arrangements proposed for the housing of the Royal Society For that purpose it was proposed to expend 28 000*l* of the capital in the hands of the Board of Manufactures A sum of 25 000*l* would go to the purchase of a building, and 3000*l* would cover the expenses of fitting up re-decorating the new premises, and transferring the library and other effects of the Royal Society from the Royal Institution The Treasury were giving the Royal Society a grant of not more than 600*l* a year At present the Royal Society received a grant of 300*l* a year which grant was paid by them as rent for the part of the Royal Institution which they now occupied In future the Royal Society would be placed in occupation of their new premises and they would also have the grant of 600*l* a year for scientific purposes and would be free from any obligation to pay rent He thought it would be conceded that the Treasury had been, not extravagant in this matter, but generous "

BY permission of the Lord Mayor the annual meeting of the British Science Guild will be held at the Mansion House on January 28 at 4 p m Mr Haldane the president of the Guild and others to be announced later will speak The Lord Mayor will preside

To celebrate the fiftieth anniversary of its foundation the Geographical Society of Vienna held a meeting on December 15 under the presidency of the Archduke Rainer, patron of the society

THE gold medal offered by the National Geographic Society, Washington for extraordinary achievements was presented to Commander Peary by the President of the United States at a banquet on December 15

THE Berlin correspondent of the *Times* states that on December 14 the German Wireless Telegraphy Company succeeded in establishing wireless telephonic communication between its offices in Berlin and the wireless telegraph station at Nauen, a distance of about twenty-five miles It is claimed that the apparatus can be adapted to any wireless telegraph installation

IN the House of Commons on Tuesday a discussion took place on the wireless telegraphy convention signed at the recent conference in Berlin, an account of which was given in NATURE of November 15 (p 59) Sir F Sassoon moved —" That in view of the experimental and undeveloped condition of radio telegraphy this House regards with apprehension any engagements hampering the complete freedom of action of the State and asks His Majesty's Government to grant a Select Committee to inquire into the proposals embodied in the Berlin Convention previous to ratification " The resolution was withdrawn after Mr Buxton Postmaster General, had announced, in the course of a detailed reply to the criticisms passed upon the convention that a select committee of inquiry would be appointed by the Government at an early period of next session

ON Friday last, December 14, there was opened in the Alexandra Park, in Manchester, a range of houses erected by the Manchester City Council for the unique collection of cacti made by the late Mr Charles Darrah of Heaton Mersey, and presented to the town of Manchester by his widow and sons The houses which were erected at the cost of 2500*l* are admirably suited for the purpose, and provide a suitable building for this splendid collection which comprises about 1200 species and varieties of *Cactaceae*, and about 400 specimens of other succulent plants

A CORRESPONDENT in Osaka sends us a cutting from the *Japan Chronicle* of October 20 in which it is reported that " a remarkable piece of crystal has been discovered on a hill at Masutomi-mura Kita Koma district Yamanashi Prefecture It is 4½ feet long and 1½ feet thick weighing more than 10 000 lb " The information is not definite enough to be of much value, but it may be pointed out that a quartz crystal of the size mentioned (4½ feet by 1½ feet) would weigh about 1000 lb, not 10 000 lb In the collection at the British Museum (Natural History) there is a crystal from Madagascar which is 3 feet long and more than 1 foot thick A crystal in Milan 3¼ feet in length and 5¼ feet in circumference is estimated to weigh 870 lb

SPEAKING at the eighth annual dinner of the members of the Medical Graduates' College and Polyclinic, held in London on December 12 Prof Clifford Allbutt who presided said it is quite impossible for teachers however eminent they may be to teach undergraduates and post graduates at the same time hence the necessity for a post graduate society of this kind The science of medicine is living and the sciences on which medicine was founded are living and post-graduates must move forward with the rest Prof Allbutt suggested that the institution should not rest until it has succeeded in bringing about in this country the establishment of a Ministry of Health

THE report and balance-sheet for 1906 of the Armstrong College Marine Laboratory Cullercoats, shows that the sum of 2048*l* has been received as donations in aid of the scheme to provide a completely equipped laboratory A marine laboratory is to be erected forthwith at a cost of 3000*l*, and Mr Hudleston the owner has agreed to let the laboratory to Armstrong College at a yearly rental of 3 per cent on his outlay An appeal is made for funds to furnish and equip the laboratory when erected, and these may be sent either to Mr A Meek at Armstrong College Newcastle upon Tyne or to Mr George Wilkinson, 1 Mosley Street Newcastle upon Tyne

ON December 6 Mr Alfred Hands delivered a lecture before the Royal Engineers at Chatham on " The Protection of Buildings from Lightning " He showed the extent of damage by lightning by means of a chart of England and Wales on which the positions and nature of objects damaged during a period of about nine years were indicated by coloured spots This included 2485 buildings of which 148 were churches Mr Hands showed that it is impossible to protect buildings efficiently by means of set rules, each case has to be studied separately, and the system of protection applied which the complications of metal in and about the structure show to be necessary Hitherto too much importance has been attached to the form and composition of the conductor and too little to the fact that its efficiency depends almost entirely on the way in which it is applied, and very little on what it is As regards the relative value of iron and copper for conductors so far as the matter concerns conductivity and the dissipation of energy, Mr Hands holds it to be of such trifling importance that it sinks into insignificance

in comparison with considerations of durability A lightning conductor is expected to last for a long time, and iron is, unfortunately, too perishable for the purpose As regards cost, an iron system, if of sufficient size to be fairly lasting, is more costly than an ordinary copper tape one

A LETTER in the *Times* reports the return of Dr Stein from his second exploration of Chinese Turkestan As before, he has combined careful surveys of the Chinese-Indian frontier with archæological work His former surveys of the farther side of the Kuen-lun have been largely supplemented and he has explored more ancient sites, revisiting also the Rawak Stupa, from which he obtained before such important archæological material More ancient documents have been secured, and we await with interest his report and hope that he will bring out another book describing his travels This though it will not possess the charm of novelty which distinguished his "Sand-buried Ruins of Khotan" (see NATURE vol lxx, p 275), and made it one of the most important archæological publications of a decade will still be most interesting as a sequel to his first work and is sure to contain matter of the greatest importance We greatly desire to hear more of the mighty Muztagh ata "Ice mountain Father" and of the other Muztagh in the Kuen-lun with the extraordinary eroded ranges of Yagan-dawan and the impassable gorges of the Yurung-kash as well as of the ancient cities of Khotan with their sand buried treasures of former civilisation

RARE birds observed at Rositten form the subject of notes by Dr J Thienemann in the June and October issues of Reichenow's *Ornithol Monatsberichte* The most noteworthy is the Indian greenish tree warbler *Phylloscopus (Acanthopneuste) viridans*

THE articles in the November issue of *Naturen* include one by Mr N J Føyn on the *Gjøa* expedition under Amundsen for polar magnetic observation a second, by Mr C F Kolderup on the San Francisco earthquake and a third by Mr J A Grieg on animal groups in the Bergen Museum The latter institution, it appears, has been endeavouring to imitate the *régime* inaugurated by Sir W H Flower in our own Natural History Museum and the article contains reproductions from photographs of groups of birds and mammals amid their natural surroundings which have been recently set up at Bergen

A MEMOIR by Prof I Toula on the dentition of *Rhinoceros (Ceratorhinus) hundsheimensis* forms article 2 of vol xx of the *Abhandlungen der k k geol Reichsanstalt* Vienna This rhinoceros which is regarded as a relative of the living *R sumatrensis* was first described in 1901 on the evidence of remains from Hundsheim Altenburg since which date additional material has been obtained In describing the dentition in detail, the author refers to that of other European Tertiary species several of which he splits up into new species and subspecies The *Rhinoceros etruscus* described by Prof W B Dawkins from the forest-bed of Pakefield he makes for example, the type of a subspecies, *R e pakefieldensis* In giving the designation *R megarhinus brachycephala* to a Continental form Prof Toula seems to be unaware that according to the rule adopted by zoologists, this name is preoccupied by *R mercki brachycephala*, Schroder

WE have to acknowledge the receipt of vol v part iii and vol vi, part i, of the Proceedings of the Rhodesia Scientific Association published at Bulawayo In addition to Mr F White's presidential address delivered on November 7, 1905, the former contains notes, by Mr. H Marshall, on birds of the Zambezi valley, geological notes on Rhodesia, by Mr C E Parsons, and petrographical notes on the oldest rocks of South Africa, by Mr F P Mennell The grasses of Rhodesia, by Mr C F H Monro and the Amantabele and other tribes of Matabeleland, by Mr H J Taylor, Chief Native Commissioner, form the chief subjects of the later issue The "black peril" looms large in Mr Taylor's paper The native, according to the author, has recently made rapid strides towards civilisation, and superstition is fast dying out "His mind is becoming more expansive, and his object is to place himself by his own efforts, if possible, on an equal footing with that of the white man There is a new era in the life of the native, and we are at the present time faced with the greatest political question of the day, all other questions sink into insignificance in comparison"

THE Journal of the Quekett Microscopical Club for November (ix No 59), among others, contains a suggestive paper by Mr J Rheinberg on stereoscopic effect and the improvement of the binocular microscope, and a very useful non technical summary of the Mendelian hypothesis with bibliography and suggestions for experiments with microscopic organisms

DR H G GAYLORD of Buffalo, details some remarkable facts suggestive of contagion among mice and rats arising from tumours believed to be cancerous (*Brit Med Journ*, December 1, p 1555) A cage was discovered in which upwards of sixty cases of spontaneous tumours occurred among rats and mice kept in it in the course of three years The fact that the location of the cage was frequently changed and that the stock was entirely renewed without permanent cessation in the occurrence of tumours, indicate that the cage itself was the source of infection

DURING the last three or four years the view has been gaining ground that the spirillar microorganisms met with in certain diseases and known as "spirochætes" are protozoan and not bacterial, in nature, and Schaudinn stated that they were probably a stage in the development of trypanosomes Novy and Knapp, however, again reassert the bacterial nature of these spirochætes on the following grounds —(1) they do not seem to divide longitudinally as do trypanosomes, (2) they multiply much more rapidly than protozoa usually do, (3) unlike trypanosomes, they are unaltered by dialysis against water, (4) they are less affected by heat, and have less avidity for air than trypanosomes and (5) with spirochætes a well-marked active immunity may be induced on inoculation (*Brit Med Journ* December 1, p 1573)

IN the Bulletin of the Imperial Botanic Gardens at St Petersburg, vol vi, part iv Mr N Busch continues his letters from the Crimea describing the plants collected *en route* Mr W I Taliew, writing on the flora around Ssergatsch, a town in the Government of Nischny-Novgorod, notes the gradual immigration of *steppe* plants, and another ecological paper is contributed by Mr B Fedtschenko on the plant associations of the lake near Borowsk indicating that it is an outlier of the more northern lakes

THE importance of forests in connection with the water supply of a country, inasmuch as they regulate the flow of rivers, prevent erosion, and help to conserve moisture, is now generally admitted This subject is touched upon in

the editorial of the *Indian Forester* (September), and is discussed in a letter from Mr A M Lushington, who draws his arguments from a consideration of the sources of the Cauvery Mr Lushington emphasises the necessity of duly conserving the forests at the river sources, and suggests that the help of Government should be invoked to provide the necessary funds, more particularly where the river runs through different States

MUCH attention is paid in various parts of India by the forest departments to the planting of avenues along the roadsides An article describing the trees suitable for the Salem district in Madras, by Mr F A Lodge, is published in the same number of the *Indian Forester* Figs, the wild mango, the tamarind, and the margosa tree, *Melia azedirachta*, are recommended as a first choice, but a more extensive list is given of trees less generally suitable although adapted to special soils Cultural directions are added with regard to setting out nurseries, transplanting and pruning

THE *Bulletin de la Société d'Encouragement* (vol cviii, No 9) contains the oration delivered by Mr Gruner at the funeral of Mr Huet the eminent civil engineer, president of the society

THE report of the judges on the trials of suction gas producers organised by the Royal Agricultural Society has been drawn up by Captain Sankey, and summaries of it are published in the *Engineer* and in *Engineering* of December 14 It forms a valuable contribution to the literature of the subject, and shows conclusively that the suction plant is well adapted for agricultural purposes Although less manual labour is required than with a steam engine, more intelligence is required on the part of the attendant to ensure the production of gas of good quality In the eleven plants of which complete figures are given, the fuel consumption per brake horse-power at full load varied between 1 04 lb and 1 48 lb The winners of the awards priced their plants at almost the same figure, 11 65*l* and 11 77*l* per brake horse power

RECENT developments in aërial navigation form the subject of an article by Major Baden Powell in *Knowledge* for December Commenting on the prevalent view that Santos Dumont's experiments constitute the first case of actual human flight, the author refers to the previous reported records of the Brothers Wilbur and Orville Wright He also expresses doubt as to how far the recent experiments in Paris have effectively disposed of the stability question From Major Baden-Powell's article we further learn that experiments with mechanically-propelled balloons are still receiving considerable attention In particular the Zeppelin airship has again been making trips and a speed of thirty miles an hour has been recorded though it would appear that the estimate was made by theodolite measurements and further information would therefore have to be placed at the disposal of a reader before any conclusions could be drawn as to the velocity relative to the wind A new Lebaudy balloon called *La Patrie* has been built for the French Government Since the appearance of Major Baden-Powell's article it has been reported in the Press that a new explosive has been prepared by the United States Government for use in aeroplane machines constructed by the Brothers Wright

THE Journal of the Franklin Institute (vol clxii, No 5) contains a striking illustration of the historical collection of more than a thousand incandescent lamps, for which the Elliott Cresson gold medal was awarded to Mr William J Hammer, of New York The collection, made during a period covering more than a quarter of a century, embodies a history that could not have been recorded in words and could not be reproduced if destroyed In the same issue Prof Carl Hering describes the Decker battery, a new form of primary battery for large outputs It is the usual bichromate cell the feature of novelty being the construction of the cell and its parts Prof A E Outerbridge reviews recent progress in metallurgy, dealing specially with high speed tool steels ferro-alloys, steel-hardening metals nickel vanadium steel alloys, blast-furnace slag cement, aluminium copper, the great increase in the production of gold and the declining production of silver

IN the *Century Magazine* for December is an article by the Hon W H Taft Secretary of War, U S A explaining why the lock system was adopted for the Panama Canal This question had been referred to a commission of thirteen of the most experienced ship canal engineers both in the United States and abroad The majority of this commission eight in number, advised a sea-level canal while the minority, consisting principally of the American engineers advised a canal with locks at a summit-level of 85 feet above the sea The final decision of the American Government and Congress has been recorded to the adoption of the lock system The reason for this may be briefly summarised as follows —The canal without locks would require a deep cutting, a great deal of which would be rock, through the summit-level at Cuelebra involving the removal of 250 millions of cubic yards The waterway through this cutting would only be 150 feet wide and 40 feet deep It was estimated that it would take sixteen years to complete the work and that the total cost including interest on the outlay, would amount to about 63 millions of pounds The lock canal, on the other hand is estimated to cost half the above sum, and to occupy only half the time in constructing The waterway will vary from 45 feet to 75 feet in depth and the width from 1000 feet over half the length 500 feet to 800 feet over a third and for about five miles 200 feet. The locks are to be in three flights with a rise of 85 feet; or a total lift of 255 feet Next to the locks, the most important work will be the enormous dam that is to be constructed to hold the water from the Chagres River which will form a lake covering an area of 118 square miles and in places eight miles wide the depth varying from 45 feet to 75 feet The dam will in fact be a small artificial mountain about 1½ miles long half a mile wide at the bottom and 135 feet high, the depth of the impounded water being 85 feet at the dam the top of which is to be 50 feet above water level

THE frequently observed fact that the spontaneous ionisation of the air when measured in leaden vessels appears to be greater than when observed in a chamber of any other metal suggests the presence of some radio-active impurity in ordinary lead An attempt to identify this constituent is described by Messrs Elster and Geitel in No 23 of the *Physikalische Zeitschrift* The fact that a solution of ordinary lead does not give an emanation proves that the radio-active element is neither radium, actinium nor radio thorium The active constituent remains in solution when the lead is precipitated as chloride and in this respect resembles radium E and radium F the fact that it shows an α radiation exclusively would suggest that it is probably radium F (polonium) Before this point can be settled measurements will have to be made of the range of its α radiation

In a communication to the Royal Academy of Belgium (Bulletin No 7, p 452) Prof Walthère Spring shows that the material obtained by decomposing a solution of hydrogen sulphide with sulphur dioxide, and formerly described as δ sulphur by Debus, who considered it to be an allotropic form of the element is in reality a hydrate having the composition S_8,H_2O The hydrate has at the ordinary temperature a vapour pressure much smaller than that characterising most hydrates When, however, it is exposed for a long period in a vacuum it gradually loses water a form of sulphur being produced which differs from the known forms in its regenerating the hydrate when left in contact with water It is interesting to note that the composition of the hydrate corresponds with the molecular weight S_8 which has been found by physical methods to characterise sulphur in solution

Mr W B Clive has published a second edition of "Graphs or the Graphical Representation of Algebraic Functions" by Messrs C H French and G Osborn The book has been expanded, chapters having been added on harder graphs and on the slope of a graph

A second popular edition of Mr Oliver Pike's "In Bird land with Field-glass and Camera" has been published by Mr T Fisher Unwin The first edition of this attractive volume was reviewed in our issue of August 30, 1900 (vol lxii, p 417) and it is unnecessary to add anything to the favourable opinion then expressed

We have received tickets for Mr Otho Stuart's revival of *A Midsummer Night's Dream* at the Adelphi Theatre We are glad to know that the management is presenting this delightful comedy which, unlike many of the modern plays, is not based upon impurity or inanity, but provides all who see it, whether children or adults with innocent enjoyment and real delight An arrangement has been made by which schools and parties of students may receive special terms of admittance, for particulars of which application should be sent to Mr C F Level at the Adelphi Theatre

A second edition of Mr J H Stansbie's "Introduction to Metallurgical Chemistry for Technical Students" has been published by Mr Edward Arnold The book assumes that those who use it are practically interested in the common metals but have only the knowledge of their properties gained by every-day observation in the workshop or foundry The scientific study of the subject consequently starts at the beginning The text is practical in character, and will be useful to the technical students for whom it is intended

OUR ASTRONOMICAL COLUMN

Systematic Stellar Motions —In a paper submitted to the Royal Astronomical Society Mr A S Eddington discusses the proper motions of the stars contained in the Greenwich-Groombridge catalogue from the point of view that they are not haphazard, but may be considered as belonging to two defined systems

It has been generally assumed that these proper motions were proper to the individual stars only, but Prof Kapteyn recently concluded that this assumption was erroneous, and that they might be classified into two "drifts," which are in relative motion, the one to the other Mr Eddington's results confirm this theory quantitatively In each drift the velocities relative to the system of axes of the drift are quite haphazard, but this system of axes has a velocity which is defined as the velocity of that drift

On analysing the figures obtained for the regions discussed, in order to find the directions of the two drifts in each region Mr Eddington found that the stars of drift i have a common velocity, relative to the sun, away from a point near to R A 18h, dec +18°, and that the best point for the apex of drift ii is about the position R A 7h 30m, dec +58° The velocity of the first drift relative to the sun is much larger than that of the second, the ratio being about 17 5, and from an investigation of the *magnitudes* of the proper motions there appears to be no appreciable difference in the mean distances of the stars of the two drifts (the *Observatory*, No 377)

The Spectrocomparator —An extremely interesting instrument, devised for the measurement of the spectral displacements in the determination of stellar radial velocities, is described by Dr J Hartmann in No 4, vol xxiv, of the *Astrophysical Journal*

The usual method employed in measuring the "Doppler" displacement has been to measure the displacement of each individual stellar line in regard to the corresponding line in a terrestrial spectrum, but in Dr Hartmann's instrument a large number of lines are compared with those of a standard solar spectrum at one time, so that a stellar spectrum rich in lines, which would, by the older method have taken days to measure, may now be measured in an hour or two Details, too numerous to mention here, are given in Dr Hartmann's paper, and are well illustrated by diagrams and worked examples

Measurements of the Effective Wave lengths in Stellar Spectra —The position of the "effective" wave-lengths in stellar spectra, that is, the position of the radiations which, in the combined radiations of a complete spectrum, appeal most strongly to the eye, is of great importance in double-star observations For this reason Dr H E Lau has determined this position in seventy stars, by Prof Comstock's interference method, and publishes the results in No 4134 of the *Astronomische Nachrichten*

The stars which have been examined are arranged in groups according to the Harvard classification, and the distance between the conjugate spectra of the first order is given for each object This quantity may be converted into wave-lengths by the application of a known factor

Early Observations of Jupiter's Sixth Satellite —On examining the Harvard photographs of Jupiter, Miss Leavitt found the image of the sixth satellite on two taken in 1894 and on nine taken in 1899 These plates were measured, and the results of the measures and their reduction are given and discussed in No ii, vol lx, of the Annals of Harvard College Observatory It appears that Miss Leavitt marked and measured this satellite when examining some of these plates on December 10, 1904, but concluded that it was probably an asteroid near to its stationary point

Observations of the August Meteors —In No 4132 of the *Astronomische Nachrichten* Prof von Konkoly records the results of some meteor observations made at the O Gyalla Observatory in July and August last These results show that the maximum of the shower occurred on August 12, on the night of which 158 meteors were observed at O'Gyalla and 251 at the subsidiary station at Nagy Tagyos On August 13 the corresponding numbers were 111 and 175

GEOLOGY IN THE UNITED STATES AND CANADA

Glacialists will be interested in the short sketch of the drumlins of south-eastern Wisconsin contained in Bulletin No 273 of the U S Geological Survey[1] It is a preliminary record of a detailed study of the post-Pleistocene deposits of the district which embraces part of the ground moraine of the Green Bay glacier—in which most of the drumlins lie—and part of that of the Lake Michigan glacier, as well as an earlier Iowan or Illinoian glaciation The relations of the drumlins to eskers and to the terminal moraines and rock mounds were investigated The map shows most clearly the arrangement of the drumlins to correspond with the lines of flow of the deploying glacier

Bulletin No 265[2] contains a short account of the struc-

[1] Bulletin No 273 "The Drumlins of South eastern Wisconsin. (Preliminary Paper) By W C Aldin (1905)

[2] Bulletin No 265 'Geology of the Boulder District of Colorado By N M Fenneman (1905)

ture and stratigraphy of the district, and such features as mesas, slip faults, and lake basins are incidentally described. The well-known Wyoming beds are still tentatively retained in the Triassic system on very poor evidence, and notwithstanding the different interpretation placed upon them by Mr Darton The main purpose of the paper is to explain the position of the oil-bearing beds at Boulder These are shown to be irregular sandstones in the Pierre shales (Cretaceous) The paying beds are limited to a narrow line over the crest of a shallow anticline and over one or two subsidiary folds Much time and money appear to have been wasted through carelessness in keeping the journals of bore-holes, and by the reckless "shooting" of the wells

Not long ago we had occasion to notice a bulletin by Mr T N Dale dealing with the much-discussed Taconic area The same author has now (Bulletin No 272[1]) called upon his long experience of the region to produce in a pamphlet, of no more than fifty pages, a charmingly lucid exposition of its physical geography With the maps, sketches, and photographs, this will be an ideal guide-book to the district for intelligent students

In Professional Paper No 43[2] Mr Lindgren gives a detailed description of one of the largest copper-producing districts in the United States The oldest rocks are pre-Cambrian granites and schists over them lie Palæozoic formations, comprising Cambrian quartzites, Ordovician limestones, shales possibly of Devonian age, and pure limestones of the Carboniferous Resting unconformably upon the Palæozoic strata are Cretaceous shales and sandstones After the deposition of the latter formation, a second granitic intrusion, with dioritic porphyries, penetrated the rocks in sheets, laccolites, and dykes Then there followed a period of uplift and faulting, succeeded by great volcanic effusions of basalt, rhyolite, and some andesite A remarkable Quaternary deposit, the Gila conglomerate, at the foot of the mountains bears witness to the erosion that has exposed the older rocks in the centre of the district

The ore deposits are primarily dependent upon the intrusions of porphyry, where it came in contact with the limestones and shales of the Palæozoic series extensive contact metamorphism resulted, not only near the main mass, but within the range of influence of the numerous dykes The limestone has suffered most, in some cases being converted into an almost solid mass of garnet Magnetite, pyrite, chalcopyrite, and zinc blende appear to have been intruded into the altered rock from the porphyry magma Subsequently, oxidising waters have converted the sulphides into carbonates, malachite and azurite are the most common ores The zinc blende has been carried away as zinc sulphate The magnetite and garnet have been much decomposed, yielding silica and limonite

These ore bodies, though somewhat irregular, are mostly worked along the bedding, frequently by tunnels, since they lie at no great depth In addition to the above ore bodies, there are numerous veins of pyrite, chalcopyrite, and zinc blende, these have been greatly enriched by the secondary deposition of chalcocite on the pyrites, both in the veins themselves and in the adjoining impregnated porphyry Some interesting observations are made on the action of sulphuric acid solutions, and on the influence exerted by kaolin in enriching the ore A new mineral species, coronadite, a lead-bearing manganite, is described on pp 103–5

This paper contains a good deal of interesting matter and is illustrated by good maps and a series of capital photomicrographs of the ores within the rocks

The thoroughness with which the U S Geological Survey

[1] Bulletin No 272 "Taconic Physiography" By T N Dale (1905
[2] Professional Paper No 43 "The Copper Deposits of the Clifton Morenci District, Arizona By W Lindgren (1905)

tackles problems of local water supply could not be better exemplified than by Professional Paper No 44[1] Naturally the greater part of this bulky volume is occupied by material of purely local interest, that is, with detailed descriptions of well sections, but the brief outline of the geology of Long Island and an account of the elaborate procedure adopted for determining the rate of flow in underground water are capable of more general application

British geologists will be interested to note the suggestion to use the terms "wold" and "vale" in a restricted sense to replace the rather loose use of escarpment and cuesta, which are here more precisely defined, but of more importance, and quite opportune, are Mr Veatch's conclusions as to the cause of the folding of strata at Gay Head, this he unhesitatingly ascribes to the thrust or drag of a continental ice-sheet The volume is liberally supplied with maps

The fifth volume of the General Reports of the Maryland Geological Survey[2] is, as usual, a businesslike and well-finished production It contains the second report on the magnetic work in Maryland, by L A Bauer the third report on the highways of Maryland by A N Johnson, and an elaborate report on the coal deposits of the State, by Prof W B Clark and others

Bulletin No 268[3] contains a descriptive account of

FIG 1 —Bald of Big Yellow Mountain, Mitchell County, N C From "Southern Appalachian Forests

Foraminifera collected by Prof J C Branner from the Monterey shale on Rancho del Encinal, near Asuncion Station, in San Luis Obispo County, California The reader is left in some confusion after studying the brief prelude to the detailed descriptions of Foraminifera, for Prof Branner who writes the geological introduction makes it clear that the shaly series is very frequently sandy, and definite interbedded sandstones are not uncommon On the other hand, Mr Blagg (p 11) makes the statement that "The absence of the arenaceous genera undoubtedly shows the purity of the waters in oceanic circulation during the Miocene, and this evidence is still further substantiated by the fine argillaceous and silt character of the deposit in which the Foraminifera are deposited (*sic*) The Foraminifera, in fact, constitute a large portion of the entire mass of the marl itself" On the previous page (p 10), however, Prof Branner says, "the bulk of this shale is made of diatom skeletons" Plate 1 representing a sandstone intrusion in the Monterey shale, is by no means a convincing illustration

The fossils described in Bulletin No 266[4] were all collected from the Malone Mountain and the immediate

[1] Professional Paper No 44 "Underground Water Resources of Long Island, New York By A C Veatch C S Slichter I Bowman W O Crosby, and R E Horton (1906)
[2] Vol v Maryland Geological Survey (1905)
[3] Bulletin No 268 "Miocene Foraminifera from the Monterey Shale of California By R M Bagg, jun (1905)
[4] Bulletin No 266 "Paleontology of the Malone Jurassic Formation of Texas By F W Cragin, with notes by T W Stanton (1905)

neighbourhood Notwithstanding the presence of the genus Ptychomya, the affinities of its fauna clearly refer the Malone formation to the Jurassic system New species of Perisphinctes, Olcostephanus, Nautilus, Trigonia, Natica, Nerinea, Nerinella, Martesia, Pholadomya, and others are figured and described

Bulletin No 270[1] contains records of borings and shallow excavations, with notes on the nature of the rock From these data sectional elevations have been prepared traversing the district in many directions Information of this kind, in the same handy form, would be of great value to engineers and contractors in the London area as it is no doubt in New York

Bulletin No 267[2] contains a short discussion of the problem of the classification and nomenclature of the great series of alternating magnesian limestones and sandstones known as the "magnesian series" or "Ozark series" (Cambrian and Ordovician) The ore deposits do not appear to possess any striking features

A short description of the stratigraphy of the region (mainly Carboniferous), with particulars of the mineral resources is given in Bulletin No 256[3] There is a coloured map

Taken together Bulletins Nos 247, 251, 263[4] give an

FIG 2—Land Erosion near Marion, N C Showing rapid erosion of soil by heavy rains when the forest cover is reduced or destroyed From Southern Appalachian Forests

excellent survey of the conditions of gold mining in Alaska Nos 247 and 251 deal with the geology of their respective districts, No 263 contains a wealth of information upon all the subjects that fall within the scope of the title, and no miner should venture to Alaska without a copy All three bulletins are well illustrated

A more generalised account of the same region is contained in "The Geography and Geology of Alaska," by A H Brooks (Professional Paper No 45, 1906[5]) This well-illustrated volume deals with the climate, the drainage, the history of explorations and surveys, and the geology. In the last-named section an elaborate table is provided giving the correlation of the strata in the western United States and Canada A bibliography is appended

Professional Paper No 41[1] contains a good deal of useful information upon the mineral resources of the central copper region There is also a short account of the volcanic rocks of Mount Wrangell and of the glaciation of the Copper River basin There are numerous interesting illustrations

"The purpose of Mr Alden's paper[2] is to throw, if possible some fresh light on the relations which existed during the later stages of the Glacial epoch between the glaciers of south eastern Wisconsin" It is an interesting study of the phases of glaciation and deglaciation in an area of moderate size The principal facts are graphically illustrated in a series of admirable maps, prepared by the author to show the relations of the several glacial deposits at different stages

Professional Paper No 30 Parts of this volume[3] are excellent, but we are constrained to ask, For whom is it intended? Is it for the West Kentucky miner? Then why burden him with a dissertation on Carboniferous stratigraphy and palæontology? On the other hand, if it was meant for the help of palæontologists, why should their troubles be increased by recording new species under the title "Lead, Zinc, and Fluorspar Deposits"? As for the new species themselves, they may be found beautifully figured but the diagnoses are very meagre

The bulk of Professional Paper No 37[4] is a dreary mass of statistics relating to the forest conditions of southern Appalachia but it contains a number of illustrations which will appeal to all who are interested in problems of afforestation and water supply The forest suffers from ill-regulated lumbering and from fires, but far more damage is done not to the forest alone, but to the water supply, the scenery and the agriculture of large districts by the clearing of land for farm purposes on high ground and steep slopes The rainfall on the north-western slopes ranges from 40 inches to 50 inches, on the south-eastern slopes from 60 inches to 70 inches, and heavy downpours are common The two figures here reproduced bring out very clearly the cause of the trouble and one of its effects

In Professional Paper No 38[5] is a careful description of the Bingham mining district, where low-grade copper and rich silver-lead ores occur in Carboniferous strata and in the later monzonite intrusions

Professional Papers Nos 40 and 47[6] are two important palæontological works, both are illustrated with a large number of beautiful plates

It is not every mineral district that boasts of so elaborate a memoir as Professional Paper No 42[7] within five years of its discovery This paper deals with the geology, petrology faults, and veins, and gives details of each of the mines The temperature in the Tonopah mines shows an abnormally rapid increase with depth, comparable to that in the Comstock

In Professional Paper No 49[8] a general account is given of the Cumberland Gap coalfield Kentucky All the rocks of this basin are of the age of the Pottsville group of the Pennsylvanian coalfield The field has only been exploited since 1892, eight seams are mined at present, their thickness ranges from 4 feet to 6 feet

The Annual Report of the Geological Survey of Canada

[1] Bulletin No 270 The Configuration of the Rock Floor of Greater New York By W H Hobbs. (1905)
[2] Bulletin No 267 "The Copper Deposits of Missouri By H O Foster Bain and E O Ulrich (1905)
[3] Bulletin No 256 Mineral Resources of Elders Ridge Quadrangle, Pennsylvania By R W Stone (1905)
[4] Bulletin No 247 The Fairhaven Gold Placers, Seward Peninsula Alaska By F H Moffit (1905) Bulletin No 251 The Gold Placers of Fortymile Birch Creek and Fairbanks Regions, Alaska By L M Prindle (1905) Bulletin No 263 Methods and Costs of Gravel and Placer Mining in Alaska By C W Purington (1905)
[5] Professional Paper No 45 "The Geography and Geology of Alaska By A H Brooks (1906)

[1] Professional Paper No 41 "Geology of the Central Copper River Region Alaska By W C Mendenhall (1905)
[2] Professional Paper No 34 "The Delavan Lobe of the Lake Michigan Glacier By W C Alden (1904)
[3] Professional Paper No 30 "The Lead Zinc and Fluorspar Deposits of Western Kentucky By E O Ulrich and W S Tangier Smith (1905)
[4] Professional Paper No 37 "The Southern Appalachian Forests By H B Ayres and W W Ashe (1905)
[5] Professional Paper No 38 "Economic Geology of the Bingham Mining District Utah By J M Boutwell and others (1905)
[6] Professional Paper No 40 "The Triassic Cephalopod Genera of America By A Hyatt and J P Smith (1905) Professional Paper No 47 "The Tertiary and Quaternary Pectens of California By R Arnold (1906)
[7] Professional Paper No 42 "Geology of the Tonopah Mining District, Nevada By J E Spurr (1905)
[8] Professional Paper No 49 "Geology and Mineral Resources of Part of the Cumberland Gap Coalfield Kentucky By G H Ashley and L C Glenn

for 1901[1] (published 1905) contains, in addition to the summary report (published in 1902), a report on the Klondike goldfields, by R G McConnell, 1905, a report on an exploration of Ekwan River, Sutton Mill Lakes, by D B Dowling, 1904, Dr Barlow's elaborate report on the nickel and copper deposits of the Sudbury mining district, 1904, and other papers Both volumes are illustrated and accompanied by separate portfolios of maps The volume for 1902-3 contains the summary reports for 1902 (published in 1903) and for 1903 (published in 1904) There is also a report on the coalfield of the Souris River, East Assiniboia, by D B Dowling and the "Section of Mines" annual report for 1902

SCIENTIFIC FISHERY INVESTIGATIONS

IN the unavoidable absence of the Chancellor of the Exchequer, Mr R M'Kenna received a deputation at the Treasury on December 18 in support of the application of the Marine Biological Association for a grant to continue the scientific fishery investigations which are at present being conducted in the North Sea and English Channel The deputation was introduced by the Right Hon Austen Chamberlain, M P, ex-Chancellor of the Exchequer, and among those present were Prof E Ray Lankester (president of the Marine Biological Association), Sir Michael Foster, Sir William Ramsay, Mr A E Shipley (chairman of the council), Sir Charles Eliot, Mr Chas Hellyer Mr J A Travers Dr Chalmers Mitchell, Prof L A Minchin, and Dr H R Mill

In introducing the deputation, Mr Austen Chamberlain stated that, as a former Chancellor of the Exchequer, it had been his duty to review the work which had been done by the Marine Biological Association, and he had come to the conclusion that it was most necessary and that it had been efficiently performed He considered that British Governments of both parties should do more to support both science and art Prof Lankester gave a brief account of the history of the Marine Biological Association, and explained the circumstances in which the association undertook, at the request of His Majesty's Government to carry out the English portion of the international scheme of fishery investigations He directed attention to the fact that the present application of the association for funds to continue their researches had received the special support of the Royal Society, which recorded in a strong minute its appreciation of the value and efficiency of the work being done

Mr A E Shipley said the Government has gained directly and in money by entrusting the North Sea work to the Marine Biological Association He referred to the importance of extending over a sufficient period of years the kind of investigation which the association is making Only so can the effects of secondary causes and exceptional fluctuations be eliminated from the essential, primary normal factors While time advances in an arithmetical progression so does the value of the results increase in a geometrical ratio Mr Shipley gave a short *résumé* of the work accomplished and because it has furnished the problems of most pressing importance he confined his remarks chiefly to the plaice During the last four years the association has devoted much hard work to tracing the life-history and the distribution of this species throughout the North Sea, with the result that many important facts concerning it have been established Similar investigations have been carried on, but not yet so thoroughly, into the life-histories the distribution the migrations, and rate of growth of many of the other food fishes the cod, the haddock, the sole the turbot, and others Special experiments have been made on the *Huxley* to determine the vitality and the extent of injury inflicted upon trawl-caught fish by the operations of trawling The hydrographic observations and the investigations into the minute organisms which crowd the surface of the waters and form the ultimate food of fish have been efficiently carried on in accordance with the programme laid down by the international conferences In this work especially the Plymouth steamer, the *Oithona* has supplemented and helped the *Huxley* The association asked for a continuation of the grant which for the last five years the Government has made towards the expense of carrying on the English part of the North Sea international investigations A grant of 6000*l* a year is needed to continue the international work, and a grant of 2000*l* for the work on the south coast, making a total grant asked for of 8000*l* Next spring, for the first time, the International Congress has been invited to meet in England There will be gathered together in London some thirty or forty of the leading men of science from Russia, Finland, Sweden, Norway, Denmark, Germany, Holland and Belgium It will be a pitiful thing, and also a deep humiliation if we have to greet these gentlemen with the tidings that England, who takes from the North Sea far more than all the other eight countries together, more, in fact than 90 per cent of the total yield, is too impoverished to continue to do her share of this important work

Sir Michael Foster, speaking on behalf of the British Science Guild considered that the money asked for ought to be regarded as of the nature of an investment, and not as expenditure He believed that scientific investigation was the only sound foundation upon which fishery legislation could be framed, and that experimental legislation which was the only possible alternative to experimental research would involve the country in far greater expenditure than the small sum required by the Marine Biological Association

Mr Charles Hellyer chairman of committees of the National Sea Fisheries Protection Association speaking as a practical man connected with the fishing industry, emphasised the importance to the industry of the knowledge being accumulated by the scientific investigations now in progress

Mr J A Travers, in the absence of the Prime Warden referred to the support which the Fishmongers' Company had always given to the work of the Marine Biological Association in the belief that an increase of scientific knowledge was bound to be advantageous to the best interests of the fishing industry

Dr H R Mill spoke of the very valuable results which had been obtained from the hydrographical work carried out in the North Sea and adjacent waters during recent years and expressed the view that the time was not far distant when it would be possible to predict the movements of the migratory fishes from a knowledge of the hydrographical conditions of the sea

Mr M'Kenna in reply to the deputation, stated that after what had been said there could be no question as to the value of the work upon which the Marine Biological Association was engaged But the demands upon the national Exchequer were very heavy and as a matter of experience they found that the satisfaction of one demand led to a number of others being brought forward He promised to lay the views expressed by the deputation before the Chancellor of the Exchequer, who would he had no doubt, give them his most careful consideration

AGRICULTURAL RESEARCH

IN concluding a course of Cantor lectures at the Society of Arts on Monday on the subject of "Artificial Fertilisers," Mr A D Hall, director of the Rothamsted Experiment Station, pointed out that only by continued investigation and experiment can a knowledge be obtained of the conditions necessary to make the maximum profit out of the land crops and stock The teacher can only hand on what is already known and much yet remains unknown about the growth of our commonest crops and the action of standard fertilisers Adequate provision for scientific investigation of agricultural matters is of national importance as the following remarks made by Mr Hall show but though a few counties and other local bodies are carrying out demonstrations Rothamsted with its comparatively small endowment, remains practically our only experiment station where problems in agricultural science are studied with the object of making new knowledge and State aid for research amounts only to a few hundred pounds a year for the whole country

The grants of our Board of Agriculture for agricultural

[1] "The Annual Report of the Geological Survey of Canada for 1901 (1905) With separate folio of maps The Annual Report of the Geological Survey of Canada, vol xv 1902-3 (1906)

research during the past year amounted to 425*l*, while the corresponding grant in the United States of America (salaries and administration expenses being excluded in each case) was more than 150,000*l* It is true that in both countries the local authorities also spend some money on agricultural experiments, but the same disproportion would probably be found between the respective amounts if the figures could be arrived at.

Are we to take it, then, that these figures represent the relative importance of the agriculture of the two countries, or does the larger figure indicate the greater need of the American farmer for experiment and investigation? The exact contrary is the case, in the British Isles we have to farm with dear land, dear labour, and a number of charges due to the proximity of a high civilisation Farming in consequence can only pay when there is a considerable monetary return per acre, and the bigger yield necessary involves intensive cultivation, the purchase of fertilisers, and the employment of skill, which are all needless to our competitors on a virgin soil But each increase in the expenditure and skill necessary for the crop means a greater opening for knowledge and investigation, science can do little to save money for the man who merely stirs the surface of a virgin prairie scattering in the seed meanwhile, and then leaves it to take its chance until harvest Compare with such a farmer the highly technical routine of the hop-grower who spends 50*l* per acre before he harvests his crop his repeated cultivations his manurings his sprayings for various ends, it is with this kind of crops that science can find profitable employment

Looking at the average yields of the various countries of the world, we find that Great Britain is the most intensively farmed country, it obtains the biggest crops per acre, it has to spend the most to obtain them Furthermore the biggest crop the greater are the risks of disease and blight the greater are the difficulties in securing high quality Here, then in Great Britain exists the greatest need for knowledge and investigation, we cannot even always beg knowledge from wiser countries for many of our problems are special, and brought about by the very conditions of high farming which prevail here England was the first country to start an experimental station, yet Rothamsted still remains the only institution solely devoted to agricultural research in the British Isles, if we except the farm of the Royal Agricultural Society at Woburn The income of the Rothamsted station, derived solely from private benefaction, is about 2600*l* a year, in the United States each of the fifty-three States possesses a station receiving 3000*l* a year from the Federal Government besides what the State itself may contribute, in addition to the great central department of agriculture to which reference has already been made

SOME NEW METHODS IN METEOROLOGY[1]

PROF BIGELOW has here collected six studies The first four deal with diurnal periods —(i) of temperature, (ii) of barometric pressure, (iii) of vapour tension, electric potential, and coefficient of dissipation, (iv) of terrestrial magnetism, (v) treats of the variable action of the sun and its effects upon terrestrial weather conditions, whilst (vi) is a general review of the status of cosmical meteorology

The immediate occasion, the author tells us, for these studies was the necessity of deciding upon the best lines of work for the new "Mount Weather" Observatory at Bluemont, Va, which is intended to serve as a centre for research in connection with the U S Weather Bureau This observatory is to have on its staff experts in various departments, and there is to be an advisory committee of which Prof Bigelow is described elsewhere as chairman

Several of Prof Bigelow's views as to the prosecution of the higher meteorology have much to recommend them as, for example the following —"If cosmical meteorology is to be established then all rough and ready methods must be abandoned, and the work of computing and discussing the data must be placed in the hands of physicists and astro-physicists who possess scientific instincts and training" (p 48), or again —"We must waste nothing by using bad methods of work and unskilled men" (p 51)

But Prof Bigelow possesses, apparently, a duality in his nature, and the following are examples of his second self.— "In the midst of this concatenation of forces the terrestrial magnetic field stands out as the best unifier or integrator It is the most sensitive and delicate pulse which we possess, having one throb in the solar mass, and the other in its synchronism with the earth's meteorological elements" (p 48). This seems not unworthy of Colonel Starbottle addressing a jury, but what exactly does it mean? Here, again, is what we are told of the sun — "Recent computations indicate that at the centre there is a nucleus which is nearly as solid as the interior of the earth, with a temperature of about 10,000° C, the average density is 1 43 times that of water, and this is located at half the distance from the centre to the surface" (p 39)

Feeling doubts of our capacity to follow with advantage Prof Bigelow's highest flights, we have devoted more attention to his studies on the diurnal variations The view to be taken of these must depend on whether they are intended as examples of the methods to be followed by the Mount Weather Observatory, or whether they are simply illustrations of the "rough-and-ready" methods the abandonment of which the author elsewhere recommends Study i deduces from continuous temperature records at Blue Hill Observatory, and from observations made during or in connection with kite ascents there, the diurnal variation of temperature at a series of heights for every month of the year The final results are embodied in Figs 14 to 25, the diurnal variation being assumed negligible at the height of 3400 metres the whole year round The original data are not given, and the methods of manipulating them are only indicated generally Of the probable value of the results no estimate seems possible Study ii gives some general, but not very lucid information about the diurnal variation of barometric pressure Of the amplitude of the 24 hour term it says, not incorrectly "it is very different at neighbouring stations" Yet Prof Bigelow obtains Fourier coefficients for a composite diurnal inequality based on data from Boston, New York Washington, Buffalo, and Cleveland Again we are told in the general remarks that the amplitude of the 24-hour term is from one-fourth to one-half that of the 12-hour term But in the composite case treated by Prof Bigelow the 24-hour term is larger than the 12-hour term in the summer months and the arithmetic means from the twelve monthly values of the amplitudes seem closely alike for the two waves

In the calculations, the diurnal variation is assumed to be *completely* accounted for by three waves of periods 24, 12, and 8 hours If $[n]$ denote the departure at hour n from the mean for the day, then the contributions to $[n]$ from the 12- and 8 hour waves are respectively

$$\tfrac{1}{2}\{[n]+[n+12]\} \text{ and } \tfrac{1}{3}\{[n]+[n+8]+[n+16]\},$$

and what remains after subtracting these two contributions from $[n]$ is *assumed* to represent the contribution of the 24-hour wave This method cannot be recommended even for rough preliminary work, unless the 24-hour term is largely dominant and the Fourier series is known to converge very rapidly In the present instance the amplitude of the 8-hour wave is, according to Prof Bigelow's figures, about half that of the 24-hour wave from November to February In these months the observational data would certainly give an appreciable 6-hour term The same method is then applied to the diurnal variation of temperature (with sign reversed) as deduced in Study i for heights of 195, 400, and 1000 metres at Blue Hill The results for the 8-hour wave at 195 metres during the summer months at once arrest attention In July, for instance, no hourly value assigned to this wave is positive This seems to be due, not to misprints—though these are somewhat numerous in the tables—but to error in the figures for the diurnal inequality itself If the *twenty-four* hourly differences from the mean are summed algebraically, there is in most months a substantial remainder, showing that the mean value for the day has not been correctly taken

Limits of space allow only of brief reference to other

[1] Studies on the Diurnal Periods in the Lower Strata of the Atmosphere Reprints from the *Monthly Weather Review* 1905 By Prof Frank Hagar Bigelow (Washington Weather Bureau, 1905)

matters. Tables iii to vi, p 23, and numerous curves deal with diurnal variation of vapour pressure at Parc St Maur, and at Blue Hill at several levels Tables vii and viii and Chart xii deal with electric potential at Greenwich for each month of the year, and with seasonal data at Perpignan and Paris From a study of these the author advances in Chart xiii, sect ii, as the representative curve of the diurnal inequality one possessing *five* maxima! A very similar curve—based on results by Zölss and Gockel—is given for electric dissipation The conclusions embodied in these curves cannot be recommended for general acceptance The same remark applies to the conclusion, on p 21, that "the (earth's) electrostatic field varies inversely to that of the solar energy" The sole basis for this view seems to be Table ix, p 24 and Fig 53, which are regarded as proving a parallel variation from year to year between the number of solar prominences and the reciprocal of a quantity supposed to represent the mean annual potential gradient at Greenwich

The diurnal variation of the magnetic field seems to be ascribed to up and down movements of positive ions in the atmosphere, these are supposed to indulge a preference for cold air during the day As to magnetic storms, the author's theory is even less clearly stated, but he apparently regards it as supported by the rapid rise towards 1 p m in the frequency figures given by Mr Maunder for the hour of commencement of magnetic storms at Greenwich from 1882 to 1903 The author is presumably unaware that Mr Maunder has since attributed this sudden rise to a cause having nothing to do with terrestrial magnetism, and that it is not shown in figures he has given for the epoch 1848 to 1881 (*cf Phil Mag*, September 1905, p 306) In opposition to the theory advanced by Prof Schuster and others that the magnetic diurnal inequality is due to electric currents in the *upper* atmosphere the author contends that the source is more directly thermal and confined to the lowest two miles of the atmosphere A comparatively short series of simultaneous observations at suitably chosen high- and low-level stations should be fairly decisive for or against Prof Bigelow's contention

In the above criticisms the author has been regarded as a scientific man whose aim is to convey scientific ideas to other scientific men If his aim is simply to convey to an unscientific public a general idea of the problems which present themselves in cosmical physics with the view of impressing the imagination rather than of appealing to the intelligence the case is no doubt different But on either hypothesis what useful purpose is likely to be served by the indiscriminate collection of statistics and the enunciation of vague hasty theories? A sparing use of theory may serve as a lubricant but theory when heaped upon theory is simply dust clogging the wheels of science

CHARLES CHREE

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MR J J WELCH has been appointed to the newly-established chair of naval architecture at the Armstrong College, Newcastle

IT is announced in the *Lancet* that the late Dr Gustave Schorstein bequeathed 500*l* to the regius professor of medicine at the University of Oxford for the pathological department of the medical school, 500*l* to the London Hospital, and a sum, which will probably amount to some 10,000*l*, in trust to the University of Oxford, subject to certain life interests When these are expired the capital is to be at the disposal of the University for use as the University may think fit

THE following courses of lectures for teachers have been arranged, among others, at University College, London, in conjunction with the education committee of the London County Council —"The Teaching of Geography to Children," Prof Lyde, "Some Types of Vegetation and the Conditions under which they Exist," Dr Fritsch, both courses beginning on January 17 and "The Principles of Electrical Science during the Past 150 Years," Prof Trouton, beginning on January 19

THE preliminary programme of the second International Congress on School Hygiene, to be held on August 5-10, 1907, at the University of London, South Kensington, has been issued The work of the congress will be divided into eleven sections, each presided over by an authority on the subject dealt with The organising committee is inviting educational and public health authorities, universities colleges, schools, societies, and others to appoint delegates to the meeting, and is appealing for donations to meet the large expenditure involved in organising the congress, which it is estimated will be not less than 3000*l* The president of the congress is Sir Lauder Brunton, F R S and the hon secretaries are Dr James Kerr and Mr F White Wallis

THE report of the Board of Education for the year 1905-6 is of an encouraging nature There is plenty of evidence provided that our national system of technical education continues steadily to improve The report points out that much attention has been paid throughout the country to the extension and improvement of the facilities provided for continuative education There has been marked activity in the establishment of courses of instruction affording special technical training, and the effective character of the many courses organised under varied conditions shows that local circumstances have received the consideration necessary for success in this kind of educational work Technical institutions affording whole-time training for those who can give two or more years to study after completing a secondary school course have improved and multiplied their courses of technical instruction The multiplication of courses requiring the whole time of students is a gratifying indication of the growing appreciation of the value of the work of the technical school, but this appreciation is not confined to whole-time instruction The improved organisation of the varied institutions engaged in supplementing the training which a youth receives in the office or workshop has borne fruit in many practical developments demonstrating the extent to which such further education may become a recognised element in the lives of our youths The report which runs to 106 pages deals fully with every department of elementary secondary, and technical education and shows conclusively that political controversy notwithstanding valuable work is being accomplished in the schools

SOCIETIES AND ACADEMIES

LONDON

Royal Society November 22 —"The Structure of Nerve Fibres" By J S **Macdonald** Communicated by Prof C S Sherrington, F R S

Nerve fibres teased in harmless saline solutions and examined under the microscope exhibit a series of varied appearances which are distributed in a constant order in the length of the fibre This orderly distribution is explained as due to the electrical current which traverses the fibre inwards from each injured point and which leaves the fibre to traverse the salt solution at certain definite "kathodal" points

At each injured point the source of the current the colloid material is precipitated and is surrounded by an aqueous solution By the use of definite reagents the solution is found to be a concentrated solution of a potassium salt probably potassium chloride The author in a previous paper has directed attention to the importance of this fact when injury is considered as the fatal consequence of a violent "excitation," and to the probability that "excitation" is the outcome of such a desolution of colloid material and liberation of inorganic salt to diffuse and give rise to electrical change At kathodal points a similar set of conditions is observed, in origin secondary to those already described at the current source

The injury region is abruptly limited by an adjacent "anodal region," where the material of the nerve fibre has an exceptionally fluid appearance, except in so far as this fluidity is disturbed by secondary acid formation and diffusion

The anodal region passes into the kathodal region through a graduated series of coagulative change, attended

by an increasing density of granule formations (precipitated proteid)

The distribution of potassium salt in the solutions within the fibre can be mapped out, not only by definite potassium precipitants but also by dyes which are "salted out" by potassium salts This fact is held to be of importance where in other recorded instances the "staining" effects of these dyes have been observed in nerve cells and in cells of secretory glands, since in these cases also the staining effects observed may be due to intracellular solutions of inorganic salts

The author has also made observations upon the form in which the proteid matter is precipitated in regions of the fibre of different coagulation intensity These observations have resulted in the opinion that the "neurofibrils," which are commonly described as structural elements of nerve fibres are precipitates of proteid making an appearance only when the conditions determining coagulation have a certain low value

November 22 —"On Opsonins in Relation to Red Blood-cells" By Dr J O Wakelin **Barratt** Communicated by Dr C J Martin, F R S

It is shown that—

(1) By employing phagocytosis as a test of the presence of red blood-cell opsonin and avoiding spontaneous phagocytosis by suitable conditions of experiment quantitative determinations of the opsonic content of serum may be made

(2) In the experiments made, the interaction of opsonin and red blood-cell proceeded at a rate corresponding to that exhibited in a bimolecular stoichiometric reaction

Royal Microscopical Society, November 21 Mr A N Disney vice-president, in the chair —The use of a top stop for developing latent powers of the microscope J W **Gordon** The author exhibited his apparatus, which had previously been shown to the society, and pointed out that a top stop enables the microscopist to vary the proportion between the refracted and the unrefracted light which passes the instrument and thus to render conspicuous a particular feature of the object In illustration of the results thus reached he exhibited photographs taken with an achromatic oil immersion objective of N A 1 0 to demonstrate how by means of a top stop, the objective in question could be made to equal the performance of an objective of much wider aperture

Physical Society, November 23 —Prof J Perry, F R S, president, in the chair —Electric radiation from bent antennæ Prof J A **Fleming** An account of experiments at University College, London, with radiating antennæ consisting of bent wires having the property of radiating electric waves more strongly in some directions than others The receiving arrangement consisted of a thermoelectric oscillation-detector contained in a double test-tube like a Dewar vacuum-vessel Four copper strips pass down the inner tube and platinum wires soldered to them are sealed through the glass One pair of these are connected by a fine constantan wire and the other pair by a tellurium bismuth thermojunction A high vacuum is made between the test-tubes If electric oscillations are sent through the constantan wire and a galvanometer connected to the thermojunction, this receiver can measure the root-mean-square value of the oscillations induced in any receiving antenna when the fine wire is inserted between the antenna and the earth The receiver used gave deflections almost exactly proportional to the square of the current passing through the fine wire This receiver was inserted between an earth-plate and a vertical receiving antenna The transmitting antenna consisted of a similar wire and plate Readings were taken of the current in the receiving antenna, and plotted out as polar curves corresponding to the various directions of the free end of the transmitter Curves show that the intensity of radiation in various azimuths for constant distance between receiver and transmitter becomes more unequal as the ratio of horizontal to vertical part of the transmitter increases Also all the polar curves show a minimum radiation corresponding to a direction of the free end of the transmitter such that it makes an angle of 70° to 75° with the line joining the earthed points of the transmitter and receiver The form of the polar curve observed for the same sending antenna, but with different distances between sender and receiver, varies as it should do by theory A large number of forms of antenna were examined Similar effects observed by Mr Marconi in the case of bent receiving antennæ are explained, and it is shown that these effects cannot be explained without admitting three sources of electromotive force in the bent receiving antennæ —(1) that due to the magnetic force of the incident wave, (2) that due to the electric force, and (3) an electromotive force due to the periodic insertion and removal of lines of magnetic force from the nearly closed loop formed by the bent antennæ —Auroral and sun-spot frequencies contrasted Dr C **Chree** The author has already investigated the relationships between certain phenomena of terrestrial magnetism and sun-spot frequency The present paper makes similar comparisons between sun-spot frequency and the frequency of auroras The sun spot data utilised are from the big table of Wolf and Wolfer covering the long period 1749 to 1901 Mean values have been calculated from this table for each month of the year One object was to see whether there was appreciable variation in the mean sun-spot frequencies for individual months of the year The differences between the means for individual months proved to be by no means negligible when calculated from thirty-three consecutive years, or from groups of thirty-three or thirty nine years selected as representing sun-spot maximum and minimum A comparison is instituted between mean sun-spot frequencies and mean auroral frequencies calculated for the same group of years During the periods dealt with there seemed reason to believe that variation occurred in the unit of auroral frequency To eliminate such uncertainties as far as possible, a period say poor in sun-spots is contrasted with two equal periods rich in sun spots, one preceding and the other following it An investigation is made as to whether the annual variation of auroral frequency is the same in years of many as in years of few sun-spots The evidence is not perhaps altogether decisive, but, so far as it goes it points to the conclusion that *relatively* considered, the annual variation is more pronounced when sun spots are few than when they are numerous There seems however to be a conspicuous difference between the variation in the annual auroral frequencies derived from the south and the north of Scandinavia At first sight the much greater length of time for which records exist suggests that aurora lends itself more readily than terrestrial magnetism to a comparison with sun spots - The electrical resistances of alloys Dr R S **Willows** Lord Rayleigh has given a theory intended to account for the high resistance of alloys compared with that of the constituent metals The author attempts to put this theory in evidence by measuring the resistance of an alloy with direct and also alternating currents At the instant of reversal of the latter the back E M F will assist the external E M F, and hence more current will pass, *i e* the resistance will apparently be reduced No spurious resistance could be detected A minimum accuracy of 0 02 per cent is attained

Mathematical Society, December 13 —Prof W Burnside, president in the chair —The form of the surface of a searchlight reflector C S **Jackson** The light from a source must be reflected so as to pass horizontally through a narrow vertical slit The equation of the surface is found to be of the form $r+\rho=$const where r is the distance of a point on the surface from the source, treated as a point, and ρ is the perpendicular distance of the same point of the surface from the slit treated as a vertical line The practical construction of the surface is explained The Diophantine equation $x^n - Ny^n = z$ Major P A **MacMahon** A method is explained for obtaining the arithmetically independent solutions of the Diophantine inequality $\lambda x \geq \mu y$ by forming the descending intermediate series of convergents to the continued fraction μ/λ The forms of the arithmetically independent solutions of the Diophantine inequality $x \geq N^{m} y$ are deduced, and the properties of the number z, which can have the form $x^n - Ny^n$, are determined —Asymptotic expansion of integral functions defined by generalised hypergeometric series Dr E W **Barnes** The series in question satisfy

a linear differential equation which is a generalised form of that satisfied by the ordinary hypergeometric series, and the asymptotic expansions are related to the form of the differential equation In the most important cases the asymptotic expansions become exponentially infinite at infinite distances—The potential equation and others with function given on the boundary L F **Richardson** The paper suggests a tentative method for arriving at an approximate solution of the problem of steady flow of heat in a homogeneous solid with given surface temperature by beginning with the problem of variable flow in a solid of variable diffusivity which tends to zero on the boundary—The limits of real variants J **Mercer** The paper is occupied with generalisations of Cauchy's theorem which is expressed by the formula

$$\lim_{n=\infty}(X_{n+1}-X_n)=\lim_{n=\infty}(n^{-1}X_n)$$

Royal Astronomical Society, December 14—Mr W H Maw, president, in the chair—Solar parallax papers No 5 examination of the photographic places of stars published in the Paris Eros Circular A R **Hinks** Comparisons had been made of the photographic places of stars obtained at Paris, Bordeaux, Catania, San Fernando, Toulouse and Algiers, showing many discordances, some of considerable amount The Algiers places were specially affected by "magnitude equation," the cause of which was very obscure It appeared that many of the star places are affected by errors much larger than those considered permissible in the Astrographic Catalogue—Account of the Oxford Astrographic Catalogue, vol i H H **Turner** The volume in question, which has just been published contains measures of rectangular coordinates and diameters of star images on plates with centres in dec $+31°$ The complete catalogue will consist of eight volumes, one of which will be devoted to discussions—Notes on some spectroscopic observations of the sun H F **Newall** The observations were first made with the 25 inch equatorial at Cambridge (the Newall telescope), and later with a fixed horizontal telescope, a cœlostat and auxiliary mirror the latter equipment appeared to possess considerable advantages An account was given of the preliminary experiments, the instrumental arrangements were described and some results were given of the photographic study of the bands and flutings in the spectra of sun-spots—Note on the approaching return of Halley's comet A C D **Crommelin** The author directed attention to a paper by Dr A J Ångström published in 1862, in which a mean period for the comet of 76·93 years was deduced, with inequalities due to the action of Jupiter and Saturn Dr Angstrom's results give 1913·08 for the time of the next perihelion passage while that given by the Count de Pontécoulant is 1910·37 In view of this large discrepancy of 2·7 years, it is most desirable that the perturbations should be independently computed Before the last return in 1835 there were at least five independent determinations of the orbit, and it would be a great misfortune if there is a serious error in the prediction of this return after the great success achieved in 1759 and 1835—Photographs of Mira Ceti in 1897 and 1906, by Father **Sidgreaves**, were shown There were marked differences in the relative intensities of the hydrogen lines—Dr **Lockyer** also showed photographs of the star taken at its present maximum

MANCHESTER

Literary and Philosophical Society, November 13—Mr C Bailey in the chair—Luminosity produced by the rubbing or knocking together of various forms of silica R L **Taylor.** The luminosity is connected in some way with the breaking away of small particles, mostly in the form of dust Mr Joseph Burton finds that whereas ordinary felspar only shows this property in a very small degree, the same substance previously heated almost to fusion shows it nearly as well as quartz Common glass does not show it, but a specimen of glass "frit," rich in lead and very hard, does to a slight extent The luminosity may be partly due to the hardness of the material, but that it is not entirely so is shown by the fact that whereas a slight luminosity is shown when a piece of corundum or a piece of native emery is rubbed against a piece of silica, there is none whatever when two pieces of corundum or two pieces of native emery are knocked together There is a curious odour produced by the impact of any of these bodies which become luminous, an odour which has been compared to that of ozone, but Mr Taylor has not been able to verify that observation Mr F Jones and Mr Burton also made careful tests for ozone, and both failed to obtain any evidence of its presence—The proembryo and bulbils of *Lamprothamnus alopecuroides* (Braun) Miss M **McNicol.** This plant, which occurs in various countries of Europe and also in Africa, is characterised by the possession of unicellular bulbils or tubercles, formed by the transformation of rhizoids

CAMBRIDGE

Philosophical Society November 12—Dr Hobson president, in the chair—(1) Electrification produced by heating salts; (2) secondary Röntgen rays Prof **Thomson**—The specific heat of gases at constant volume and high pressure W A D **Rudge** The author has determined the specific heat of carbonic acid by heating the gas in small steel bulbs immersed in a calorimeter containing paraffin The value obtained was about 0·45 for a temperature range of from 36° to 60°, when the gas was under a pressure of about 480 atmospheres—The radio-activity of the alkali metals N R **Campbell** and A **Wood** It is found that potassium salts show a greater radio-activity than any substance examined which does not contain a "radio active element" The activity is an atomic property, and is not due to any impurity The rays from potassium vary in penetrating power, the most penetrating rays are similar to the β rays from uranium An activity of the same nature is observed in rubidium, but could not be detected in cæsium, sodium or lithium The rays from rubidium are far less penetrating than those from potassium The ionisation caused by the rays from potassium is about 1/1000 of that caused by the β rays from a similar quantity of uranium An apparently successful attempt has been made to obtain a photographic impression caused by the rays from potassium—A relation between the ionic velocity and the volume of organic ions in aqueous solutions G A **Carse** and T H **Laby.** This is a continuation of a previous paper (Proc Camb Phil Soc, xiii, p 287, 1906) It is found that the product ionic velocity × linear dimension of the ion or *va*, is sensibly constant for the ions of twenty two amines, the mean value being 20·2, for seven homologues of aniline 18·8 for thirteen pyridines and quinolines 20·3 for five phosphines 17·6, &c The linear dimension of an ion is taken as proportional to the cube root of the ionic volume, which is deduced from molecular and atomic volumes It is shown from hydrodynamical considerations that va = const × (term depending on ionic shape)

November 26—Dr Fenton vice-president in the chair—A delicate reaction for carbohydrates Dr **Fenton** When bromo or chloro methylfurfural reacts with sodio-malonic ester in alcoholic solution a product is obtained solutions of which exhibit an intense blue fluorescence The reaction is extremely delicate, and serves to detect the most minute trace of the above named derivatives of methylfurfural It is further shown that all hexoses and polysaccharides, glucosides, &c which contain a hexose residue yield bromo-methylfurfural when acted upon by hydrogen bromide under appropriate conditions and they may therefore be readily identified by the formation of this fluorescent product—Xanthoxalanil and its analogues S **Ruhemann** The author has studied the action of ethyl oxalate on acetanilide in the presence of sodium ethoxide and has found that the compound thus formed, which is called xanthoxalanil, has the formula $C_{20}H_{12}O_3N_2$—The influence of a strong magnetic field on the spark spectra of titanium chromium and manganese J E **Purvis.** The strength of the field was 40 000 units and Prof Liveing's 21 feet concave grating spectroscope was used The general results showed that most of the lines were divided into triplets of which the middle constituent was at least twice as strong as the two outside ones although the three constituents of several lines appeared to be more nearly equal A number of lines were divided into four, and the two outside constituents of some were weaker and more diffuse than the two middle ones, whilst in several they appeared to be equally strong

Chromium λ 2866·80 appeared to divide into eight, only seen separately when analysed by a calcite prism, 3147·23, 2855·73, 2757·75 were divided into six, also only seen separated on analysis, and 2861 is divided into five. The titanium line 3252·03 is divided into six. The distances of the constituents of the divided lines were measured for a considerable number of the strongest lines, and the values of $d\lambda/\lambda^2$ calculated from them. It appeared that amongst the lines which had more than three constituents, the values for several were simple multiples of one another, and in several instances the constituents of different lines had the same values, the same general appearance and polarisation. Also the values of $d\lambda/\lambda^2$ for some lines appeared to be simple multiples of those of other lines.—The solubility of stereoisomerides in optically active solvents: H. O. **Jones.** The statement, found in certain text books, that the solubility of two optical antimers *must* be different in an optically active solvent has been put to the test of experiment, and it has been found untrue. In the cases of *d*- and *l*-camphoroximes and of *d*- and *l*-camphors in *l*-amylbromide and in dextrorotatory turpentine as solvents, the solubility of the *d* and *l* compounds was found to be the same.—Estimation of copper: W. H. **Foster.** An attempt to employ the method of Wood and Berry for the estimation of sugar, and that of Jones and Carpenter for the estimation of hydroxylamine to the determination of copper, especially in mixtures. The method was found to be simple and accurate with copper solutions using grape sugar as reducing agent. With mixtures of copper and other metals the results were generally unsatisfactory, being high when sugar was the reducing agent employed and low when hydroxylamine was used. Phenylhydrazine gave better results than hydroxylamine, but these were also below those required by theory. The method, which is really a modification of that of Schwarz, can be recommended for solutions of copper salts alone, or for solutions containing only small quantities of other metals.—The maturation of the germ-cells in the saw-fly *Nematus ribesii* (third note): L. **Doncaster.**

DUBLIN.

Royal Dublin Society, November 20.—Sir Howard Grubb, F.R.S., vice-president, in the chair.—Some injurious fungi found in Ireland: Prof. T. **Johnson.** The author dealt with certain fungal diseases, mainly from the economic aspect, such as yellow-blight and scab in the potato, "Phoma" rot in mangel and turnip, onion rot, and barley leaf-streak. The paper ended with an account of the author's discovery of the American gooseberry mildew on the red currant in co. Kilkenny, and of the steps taken by the Irish Government to check the spread of this mildew in Ireland.—A contribution to the study of evaporation from water surfaces: J. R. **Sutton.** The observations and experiments were made at Kimberley, South Africa, and under meteorological conditions, *i.e.* in the open air. It is provisionally concluded that while differences between the vapour tensions at the water surface and in the open air are competent to influence the rate of evaporation to a large extent, the intensity of the effect of vapour-tension differences is profoundly modified by the relation the temperature of the dew point bears to the temperature of the air, or, in other words, is profoundly modified by the relative humidity. The water temperatures are, as such, probably of no great importance, initially at any rate, but when considered in conjunction with the temperature and relative humidity of the air, an influence becomes apparent which so far as is known has not hitherto received due recognition. It seems to be extremely probable that after the relative humidity of the open air and the difference of vapour tension have been allowed for, much of the observed evaporation from whatsoever form of water surface or type of gauge, is due to convection currents. The effects of insolation are discussed both as regards evaporation at sea and from land surfaces, and the conclusion is drawn that too much importance has hitherto been attributed to this source of energy. In a series of experiments on the effects of electrification no difference was detected between the evaporation from insulated and uninsulated copper evaporating vessels, other than trifling differences which may be due to experimental error.

EDINBURGH.

Royal Society, November 19.—Dr. R. H. Traquair in the chair.—A new Siphonogorgid genus, with descriptions of three new species: J. J. **Simpson.** These organisms were obtained from the shallow waters of the Indian Ocean, and presented features which quite differentiated them from the other known genera of the same family.—Craniometric observations on the skull of *Equus prejvalskii* and other horses: Prof. O. Charnock **Bradley.** The general conclusions were that the wild horse had a long, narrow face, the Iceland or forest type a short, broad face, while the Celtic type occupied an intermediate position; that the orbit of the wild horse was elongated and placed far back as compared with the rounded orbits of the two other types.—Skulls of horses from the Roman fort at Newstead, near Melrose, with observations on the origin of domestic horses: Prof. J. C. **Ewart.** From a careful study of these skulls, thirteen in all, the author obtained fresh evidence in support of his theory that the present domesticated horses are descended from three distinct types, namely, the wild horse of the Gobi Desert, the Celtic type, and the forest type. The evidence from length and shape of skull, and from the estimated heights of the horses of which the skulls had been found near Melrose, was thoroughly examined, and there seemed little doubt that the Romans possessed horses of from twelve to fifteen hands in height belonging to the three types named. A remarkable feature which seemed to have hitherto escaped notice was the manner in which the forward part of the skull was bent with reference to the base, giving to some types a Roman-nose aspect, to others a straight form of face. An interesting point was that the amount of bending varied with the age of the animal, being (for example) bent at birth in the case of the wild horse, then becoming straight at sixteen months, and, finally, bent again in the adult.—The inversion of cane sugar by optically active acids: Theodore **Rettie** and Dr. W. W. **Taylor.**

December 3.—Prof. Crum Brown, vice-president, in the chair.—The sporulation of *Amoeba proteus*: Prof. J. Y. **Simpson.** The paper gave an account of the sporulation in *Amoeba proteus* without encystment, describing certain specific nuclear changes, and raising some questions in connection with the nuclear changes in the allied species *Pelomyxa palustris*.—Results of removal and transplantation of ovaries: Dr. F. H. A. **Marshall** and W. A. **Jolly.**—The influence of an excessive meat diet on the osseous system: Dr. Chalmers **Watson.**—The effects of a meat diet on fertility and lactation: Dr. B. P. **Watson.**—The effects of a meat diet on the minute structure of the uterus: Drs. Malcolm **Campbell** and Chalmers **Watson.** These three papers treated of different aspects of the same general question. In the first it was shown that in the offspring of rats fed on an excessive meat diet the osseous system was defective. The bones were invariably too soft and vascular, and frequently showed structural changes like those of rickets in the human subject. The blood-forming cells in the bone marrow were also affected, being at first increased in number and later diminished. In the second paper it was demonstrated that the reproductive power of rats fed on an excessive meat diet was much below that of rats fed on a bread-and-milk diet. Further, when the meat-fed rats had litters they were less able to feed their young owing to smaller development of mammary tissue. The third paper contained a description of the minute structure of the lining membranes of the uterus in rats fed on different diets. The prolonged use of an unphysiological diet, such as an excessive meat diet, induced structural changes in the mucous membrane of the uterus, and these changes were most pronounced in animals in which the faulty feeding was begun when the animals were weaned. Such animals were invariably sterile.—The minors of a product determinant: Dr. Thomas **Muir.**

PARIS.

Academy of Sciences, December 10.—M. H. Poincaré in the chair.—The division of labour amongst bees: Gaston **Bonnier.** The author's experiments during last summer show that the division of labour is carried out to a surprising extent among bees. Bees which are seeking for

pollen or nectar do not carry it, but merely carry the news to the hive. A number of bees are sent out to strip the flowers, a number carrying pollen only, others nectar only, others again water only, when water is needed. The number sent out is proportional to the number of flowers to be stripped, and by marking the bees with coloured talc it was proved that each bee confined itself for the time being to one class of work. The same bee might be seeking for flowers in the morning and collecting in the afternoon, but did not change the nature of its work without returning to the hive. There seemed to be something in the nature of a working arrangement between the bees of different hives, as when the work of clearing a certain area of flowers had once been commenced by a few bees from one hive, these collectors were not interfered with by bees from other hives.—Some scientific discoveries of Leonardo da Vinci: P. **Duhem**. A study of the effect of the scientific writings of Leonardo da Vinci on the work of Mersenne, Roberval, Descartes, Fabry, and Huygens.—Glycosuria without hyperglycemia: R. **Lépine** and M. **Boulud**.—The theory of ensembles: Félix **Bernstein**.—The power of orthogonal systems of continuous functions: Erhard **Schmidt**.—The calculation of limits: L. **Fejér**.—A class of differential equations reducible to linear equations: M. **Rivereau**.—The phenomena of magnetic rotatory polarisation in crystals: Jean **Becquerel**.—The motor effects of high frequency currents: H. **Guilleminot**.—A colour reaction given by reducing sugars by *m*-dinitrobenzene in alkaline solution: MM. **Chavassieu** and **Morel**. A violet colouring matter is produced. It is neither more nor less characteristic than other colour reactions of aldoses and ketoses, but has the advantage of being very easy to carry out.—A tetrabromo-derivative of methylethylketone: M. **Pastureau**. The ketone is converted into a peroxide by the action of hydrogen peroxide in acid solution, and this submitted to the action of bromine. The tetrabromide thus formed has been shown to have the constitution $CH_2Br—CO—CH_2—CBr_3$, since when heated with potassium carbonate it gives acetol.—The distribution of phosphorus in foods: M. **Balland**.—The distribution of vicianine and of its diastase in the seeds of Leguminosæ: Gabriel **Bertrand** and Mlle. L. **Rivkind**. About forty species were examined, and most of them were found to contain a diastase capable of hydrolysing vivianine. The glucoside was only found in plants of the genus Vicia, and the distribution of the two substances was very irregular even in this one genus. *Vicia narbonensis*, for example, contains neither diastase nor vicianine.—The composition of vegetable juices extracted from roots: G. **André**.—The respiration of seeds in the state of latent life: Paul **Becquerel**. It has been found that light, the teguments of the seed, and the state of hydration are all important factors in the respiration of the seed, and the effect of these may be sufficient to explain the variable results obtained by different workers on this subject.—Pollen, its origin and transformation: Germand **Vert**.—A tumour in an invertebrate, *Sipunculus nudus*: Marcel A. **Hérubel**.—A new order of dinoflagellated parasites, Blastodiniæ: Edouard **Chatton**.—The interpretation of some results in radiotherapy and an attempt at fixing a rational technique: J. **Bergonié** and L. **Tribondeau**.—The conglomerates of Messina and those of the Glokova-Varassova synclinal in Greece: Ph. **Négris**.

CALCUTTA

Asiatic Society of Bengal, November 7.—Latitude of the Presidency College Observatory: Babu Phanindra Lal **Ganguli**. A simplified method of making approximate calculations in recording observations at the Presidency College Observatory.—Further notes on earwigs (Dermaptera) in the Indian Museum, with the description of a new species: M. **Burr**. Records of new localities and the description of a new species of the genus Anisolabis.—Notes on the habits of the earwig, *Labidura lividipes*, Dufour: Dr. N. **Annandale**. This earwig is sometimes very common at light during the hot weather and rains. It uses its forceps in opening and folding its wings.—Cirrhipèdes Operculés de l'Indian Museum, de Calcutta: M. A. **Gruvel**. An account of the sessile barnacles of the Indian Museum collection, with descriptions of a new genus, Pyrgopsis, and of new species, four of the genus Verruca and one of Balanus. The genus Pyrgopsis is allied to Pyrgoma.—Note on the Houbara or bastard bustard (*Houbara macqueenii*): Lieut.-Colonel D. C. **Phillott**. An account of the habits of this bird, its food, way of hiding, &c.—Descriptions of two new Indian frogs: G. A. **Boulenger**. The species are *Rhacophorus taeniatus* from the plains of Bengal, and *Ixalus annandalii* from the Sikkim Himalaya.—Notes on pollination of flowers in India, Nos. 1–3: I. H. **Burkill**. The author describes (1) the pollination of *Thunbergia grandiflora* in Calcutta by the boring bees, *Xylocapa latipes* and *X. aestuans*; (2) the pollination of *Corchorus capsularis* and *C. olitorius*—the two jute plants—in many places in Bengal and Assam; (3) the pollination, as observed in the Simla Hills, of the flowers of *Adhatoda vasica, Dicliptera bupleuroides, Morina persica, Salvia lanata, Scutellaria linearis*, and *Teucrium royleanum*.—*Ascaris lobulata*, Schneider, ein Parasit aus des Darms von *Platanista gangetica*: Dr. v. **Linstow**. A brief note upon the features of this parasitic worm.—Notes on the fresh-water fauna of India, No. ix., descriptions of new fresh-water sponges from Calcutta, with a record of two known species from the Himalayas and a list of the Indian forms: Dr. N. **Annandale**. Two new species and a new variety of Spongilla, a new species of Ephydatia, and two of Trochospongilla are described from a tank in Calcutta. *Spongilla carteri*, Bowerbank, and *Ephydatia robusta*, Potts, are recorded from a lake situated at the height of 4500 feet above sea-level in the Central Himalayas on the evidence of floating gemmules. The list of Indian fresh-water sponges now includes nine species and varieties of Spongilla, four of Ephydatia, and two of Trochospongilla. The species recorded from Bombay are mostly different from those occurring in Calcutta.—Notes on fresh-water fauna of India, No. x.: *Hydra orientalis* during the rains: Dr. N. **Annandale**. Four tentacled individuals of the polyp have been found during the rains bearing four tentacled buds but without sexual organs. At this season they confine themselves to deep and densely shaded parts of the tank, and are small and colourless.

NEW SOUTH WALES

Royal Society, September 5.—Mr. H. A. Lenehan, vice-president, in the chair.—Port Sydney: L. **Hargrave**. The paper showed how Port Jackson might be made an up-to-date port without tampering with vested interests, present traffic, or riparian rights. The accommodation shown was 8000 yards of quay, with 40 feet of water, six miles from Redfern.—The international rules of botanical nomenclature (adopted by the International Botanical Congress of Vienna, 1905): J. H. **Maiden**. The author gives an account of the modern attempts to evolve laws for a settled nomenclature, beginning at the International Botanical Congress of Paris, 1867.

Linnean Society, October 31.—Mr. Henry Deane, vice-president, in the chair.—Contribution to our knowledge of the action of rennin: A. H. **Moseley** and Dr. H. G. **Chapman**. It was noted (1) that when milk which showed an acid reaction to litmus was neutralised with alkali, rennin ceased to produce its customary clot, and (2) that the addition of quantities of alkali insufficient to produce neutrality of reaction to litmus inhibited the clotting of the milk with rennin. Upon investigation it was found that this action was due to destruction of rennin by hydroxyl ions, and was not dependent on any specific action of the sodium or potassium ion upon caseinogen or casein.—The geology of Samoa and the eruptions in Savaii: H. I. **Jensen**. The phenomena presented by the Savaiian volcano afford some clue to the direction in which to look for future developments in the forecasting of earthquakes and eruptions. The eruption in Savaii was due to a movement along the great structural line between Samoa and New Zealand which opened the fissure in 1902. The increase of folding consequent upon rise of the isogeotherms accompanying the sun-spot maximum of 1905 caused the re-melting of magmas at a depth, and squeezed them into the fissure, whence they have been escaping from several vents. The ingress of sea-water has had something to do with the eruption, as shown by the hydrochloric acid evolved, and it should be

mentioned that the rainy season, January to March, was that of greatest activity Many points of resemblance between Samoan and Hawaiian lavas command attention —Sand-movement on the New South Wales coast G H **Halligan.** The principal factors which govern the movement of sand and shingle on the littoral being ocean and tidal currents wave action and wind, the following matters are discussed —the effects of strong and weak currents, counter currents, and currents due to tidal flow upon the direction and rate of sand-travel, the movement of beach material due to tidal current a negligible quantity, sand-movement more pronounced during flood tide as compared with ebb tide a projecting headland may cause a current on its northern or southern side according as its northern side is concave or convex or whether the headland is at right angles to the course of the current, or meets it at an angle, the influence of the prevailing and the dominant winds upon sand travel as shown by an analysis of the winds recorded at Sydney during the decade 1894–1903, and at the Clarence River from March 1877, to August 1886 the manner in which sand and shingle are moved by wave action and by currents and the reasons why the sand on the coast of New South Wales is more readily moved to the south than to the north, where strong eddy currents do not exist, predominant influence of the strong southerly winds on the movement of sand above the limit of wave action, with instances of the northerly movement of sand-dunes on the coast The minerals and genesis of the veins and "Schlieren" traversing the aegirine syenite in the Bowral quarries D **Mawson** The veins ordinarily occupy fissures which may be very local, extending only a few inches, or at other times continuous by the establishment of connections between minor openings They are classified as (1) veins of bitumen distilled from the underlying Coal-measures, (2) simple pegmatite veins of (*a*) small and (*b*) of larger dimensions, which have originated by sweating from the sides, or by the residual gaseous and more liquid contents of the solidifying rock collecting largely in the same fashion and crystallising out as a coarse-grained product, and (3) veins exhibiting well marked flow structure and of finer grain more nearly related to the aplites —The fixation of nitrogen by *Azotobacter chroococcum* Dr R **Greig-Smith** Azotobacter is a slime forming microorganism and in combination with other bacteria, such as *Bact radiobacter* and *Bact levaniformans* with which it appears to associate it quickly produces a luxuriant growth of slime on saccharine media There is also a fixation of nitrogen, but this, as has been pointed out by Beijerinck and v Delden, is caused by Azotobacter, and not by the other bacteria, which however, may render assistance The fixation of nitrogen by *Rhizobium leguminosarum* Dr R **Greig-Smith** The investigation showed that races of the nodule former can fix atmospheric nitrogen in artificial culture and that the fixation is coincident with and proportional to the formation of slime Under conditions which assist cell growth, but which preclude the formation of slime, there is no fixation, and conversely, under conditions which assist the formation such as the presence of another bacterium there is an increased fixation

CAPE TOWN

South African Philosophical Society October 31 — Dr J C Beattie president in the chair —A series of mounted Cape Alcyonaria (Cœlenterates) obtained by the Government Biological Department J Stuart **Thomson** The specimens exhibited were of remarkable beauty in form and colouring One of the most interesting of the forms exhibited was *Anthoptilum thomsoni*, a colony measuring about 3 feet long and occurring in abundance at certain places probably forming miniature animal forests at the bottom of the sea —Connection between the rainfall at Durban and at Mauritius T F **Claxton** The note arises out of an inquiry into the possibility of seasonal weather forecasts for Mauritius Examination shows that the monthly departures from average of the various meteorological elements at Durban have no connection with those at Mauritius It appears, however, that winter droughts in Durban have invariably been followed by summer droughts in Mauritius at intervals of from three to seven months, and that prolonged droughts in Natal or those commencing in the summer may be either accompanied or followed by prolonged droughts in Mauritius There is some evidence to show that the interval depends upon the time of commencement of the drought at Durban —Discussion of the errors of certain types of minimum spirit thermometers in use at the Royal Alfred Observatory, Mauritius A **Walter.** The conclusions arrived at are —(1) the minimum thermometers (even the so-called "sensitive") should never be used as ordinary thermometers, (2) the errors from comparisons at certain temperatures may be as much as 2°, (3) the absolute minima obtained with the spherical bulb thermometers may amount to as much as +3° —The chemical composition of berry wax Dr B **van der Riet.** In this paper the author drew a comparison between constants found for berry wax (from berries of *Myrica cordifolia*) and those quoted for myrtle wax (from berries of various species of Myrica), by Dr J Lewkowitsch in his treatise on the chemical analysis of oils fats and waxes

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 20.

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —The Track Circuit as Installed on Steam Railways H G Brown

LINNEAN SOCIETY, at 8 —Botanical Results of the Third Tanganyika Expedition 1904–5 Dr A B Rendle and others.—Fossil Foraminifera of Victoria the Balcombian Deposits of Port Phillip F Chapman.—*Exhibition* Albino Woodlice Wilfred Mark Webb

CHEMICAL SOCIETY, at 8 30.—A New Laboratory Method for the preparation of Hydrogen Sulphide F R L Wilson —The Reaction of Acids with Methyl Orange V H Veley —(1) Contributions to the Study of the Calcium Phosphates, I The Hydrates of the Calcium Hydrogen Orthophosphates (2) Contributions to the Study of the Calcium Phosphates, II, The Action of Ammonia Gas on the Calcium Hydrogen Orthophosphates H Bassett jun

THURSDAY DECEMBER 27

ROYAL INSTITUTION at 3 —Signalling to a Distance Ancient Ways of Signalling and their Modern Development W Duddell

SATURDAY DECEMBER 29.

ROYAL INSTITUTION, at 3 Signalling to a Distance the Invention of the Electric Telegraph W Duddell

CONTENTS

THURSDAY, DECEMBER 27, 1906.

THE THEORY OF AGGREGATES

The Theory of Sets of Points By W H Young and G C Young Pp xii+316 (Cambridge University Press, 1906) Price 12s net

CONDESCENDING to a pun, Gauss once remarked that he was more interested in notions than in notations. The theory of aggregates is so independent of the ordinary symbolism of mathematics that it requires hardly any previous acquaintance with other branches of the science from those who proceed to the study of it At the same time it is full of peculiar difficulties it abounds in seeming paradoxes and some of its fundamental problems are at the present time the subject of keen research and controversy A hearty welcome is therefore due to a work composed by authors who are familiar with all that has been published about aggregates and have themselves made important contributions to the subject

It is impossible to go into detailed criticism of this treatise without the use of technical terms which would convey no meaning to the ordinary reader, but an attempt may be made to show the general nature of this novel theory and the influence it has had and will extend, over the first principles of other parts of mathematics

The names of Cantor and Dedekind will always be associated with the first truly logical definition of the arithmetical continuum, or, which comes to the same thing of the range of a real arithmetical variable It is hardly possible to lay too much emphasis on the fact that all strictly arithmetical operations are connected with the elements (rational and irrational) of this continuum Cantor's transcendental numbers obey laws of operation different from those of ordinary arithmetic and the calculus associated with them ought to have another name

With the help of a postulate the necessity of which was first realised by Cantor and Dedekind we can establish a one one correspondence between the values of a real positive variable and the points of a finite straight line exclusive of one end if the variable is not allowed to be infinite If we extend the postulate so as to include both ends of the segment we have to include values 0 and ∞ for the variable, which from this point of view are equally definite For convenience we speak of a point x instead of saying "a point corresponding to the number x"

From the arithmetical side we have to investigate the properties of the continuum and of its parts, and the special interest of the subject begins when we consider parts which contain more than a finite set of elements The simplest of these is the natural scale 1, 2, 3 &c, its characteristic properties are that it has a natural order with a first element each element being succeeded by the next higher in magnitude and there being no last element

The set of rational numbers differs from the natural scale in some very important respects As represented by points on a line they have an order of position, corresponding to their order of size, but we cannot say that in this order any element is followed by a "next" element In fact between any two distinct rational points lie an infinite set of other rational points But Cantor was the first to point out that the rational set may be brought into a one one correspondence with the natural scale for example in the order —

$$\tfrac{1}{1}\ \tfrac{2}{1}\ \tfrac{1}{2}\ \tfrac{3}{1}\ \tfrac{1}{3}\ \tfrac{4}{1}\ \tfrac{3}{2}\ \tfrac{2}{3}\ \&c$$

where the fractions in their lowest terms are arranged so that the sum of numerator and denominator never diminishes while those with the same sum are placed in descending order of magnitude Every set which can be thus brought into correspondence with the natural scale is said to be countably infinite or to be of potency a Examples of such sets are (1) the set of all algebraic numbers (2) all points with rational coordinates in a space of n dimensions where n is any assigned positive integer

On the other hand the arithmetical continuum is not countably infinite and its potency denoted by c is of a higher order than a One of the outstanding difficulties of the subject is the question whether any set exists with a potency between a and c The most important theorem in this connection is that every perfect set is of potency c (p 234) A remarkable illustration of this is that all the points within a sphere may be brought into one one correspondence with the points on a definite straight line As might be expected the correspondence is not continuous

One of the most troublesome questions discussed in this volume is that of Cantor's potency aleph-one (p 135) Here we have a set the elements of which are sets of points the element sets recur over and over again *qua* sets and are treated as being all distinct in virtue of a criterion of order connected with a process of derivation and deduction Bernstein hopes to show that $\aleph_1 = c$

The potency of an infinite set is analogous to the number of elements in a finite set Cantor introduces symbols for potencies calls them transfinite cardinal numbers and investigates a calculus for them As pointed out on p 150 there is still a difficulty in the way of establishing comparisons between potencies really corresponding to comparisons of size between finite numbers and in any case the calculus of transfinite cardinals must greatly differ from ordinary arithmetic

Besides these ideas of order and potency, which are discussed in chapters i-v vi xi there is the additional one of content which dominates most of the rest of the book It must suffice to give a few illustrations to show the general nature of these inquiries If on a line of finite length l we construct an infinite set of non overlapping segments their content that is the sum of their lengths cannot exceed l If it is less than l, there may be left over a set of complementary segments but this is not necessarily the case as is shown by the example on p 78 Here we have a set of segments whose content is less than 0 2 of the original line yet no segment exists on the line which does not lie wholly or in part within one of the selected set The points not within any of

the selected intervals form a set of potency c. Similar theorems apply to areas and volumes: thus, if we take a unit square it is possible to "black out" a definite region within it, the area of which may be less than any *given* quantity, in such a way that no circle, however small, can be placed within the square without covering some at least of the black region, and so that the points not within the black region form a set of potency c. It should be specially noticed that although the black region is, or may most conveniently be constructed by an infinite process, it is perfectly definite, in the sense that we can say whether any given point (x, y) lies within it or not.

Another point to which attention may be called is the definition of "curve" (p. 219) as a set of points having certain properties. This is quite distinct from the idea of a path traced by a continuously moving point, and leads to very curious and interesting problems relating to rectification and quadrature.

Enough has been said to show how interesting and novel are the contents of this treatise; the examples and figures are of great help in making the general arguments intelligible, and the bibliography will enable the reader to consult all the literature relating to the subject. Finally, the appendix should not be overlooked, as it contains some important additional matter, besides a few corrections. To the latter may be added "chap. iv., § 20" instead of "chap. iv., § 3" on p. 77.

G. B. M.

METAMORPHOSES OF PLANTS.

Jugendform und Blütenreife im Pflanzenreich. By Dr. L. Diels. Pp. 130, with 30 illustrations in text, each with several figures. (Berlin: Gebrüder Borntraeger, 1906.) Price 3.80 marks.

IN this work the author has presented much interesting information from the point of view of an inquiry into the relations between sexual maturity and the conditions attained by the vegetative organs, especially where these from any cause show tendencies to marked changes of aspect during the development of the plants. Many of his examples are drawn from his personal investigations, the inquiry having suggested itself to him during a residence in Western Australia, where peculiarities in these relations appear to be remarkably frequent, and to be often traceable to the environment. He has also made a careful study of such published works as bear on this subject, and has used the materials derived from them with good effect as regards both the facts and the causes of abnormal conditions, and the inferences to be drawn from them. His statement of the whole subject, and of the conclusions that he believes can be fairly based on what is yet known of it, is well and clearly put, and shows the need of further inquiry, as well as the risk of pressing inferences beyond their fair limits at times.

The book is deserving of attentive perusal, and will suggest to the careful reader parallels among our own plants to some of the cases described, and questions in need of investigation from the new standpoint. The book opens with a discussion of the conditions that favour the attainment of sexual maturity in the normal course of development, and also prematurely, as measured by the stage of development of the vegetative organs. By selected examples it is shown how variable are the stages of progress, when judged by the leaves especially, at which sexual reproduction may occur. Attention is also directed to the assemblages of different species that exist on dry, poor soil and that are distinguished by the production of precocious flowers and fruits on ill-nourished dwarfs, as well as to the production of flowers in cultivated seedlings of various trees, as in the *Swietenia Mahagoni*, recorded by Mr. Hemsley (Hooker's "Icon." 2786), where deficiency of water appears to be the exciting cause.

The unusual precocity of reproduction is most evident where there is naturally a succession of leaf-forms before the normal period of flowering is reached, some of these being regarded as characteristic of the immature, and others of the adult plant. For the definite grades in such a succession Dr. Diels employs the term "Helikomorphie," the whole being included in the "Heteroblastie" of varied forms of parts having the same morphological value. The significance of the helicomorphies, where not of the grade usually associated with flowering, is shown to differ in different plants. In some even those characteristic of the normal immature plant may not be fully exhibited. In others these may be fully shown, but those of the adult may remain undeveloped or arrested. The causes that lead to such departures from the usual course can be shown to lie in the environment in some cases, but in others they cannot yet be explained. Among the more frequent causes of arrest and retention of immature characteristics are influences that interfere with growth, such as deficiency of water in dry soils, inclement weather at high elevations, shading and overcrowding, the plants grown under such conditions showing an unusual tendency to flower while having leaf-organs of the normal immature grade.

A comparison of allied species shows that the normal youthful helicomorphy of one may be very similar to the normal adult condition of another that lives in less favourable surroundings, *e.g.* in *Ranunculus sceleratus* and *R. pygmaeus*.

The importance of a thorough comprehension of these variations, of their significance in the life of each species, and of their value as indications of relationships between species or larger groups in classification, is self-evident. Embryology has not afforded like help in systematic botany to that obtained from it in zoology. In some cases seedling plants for a brief time show characters very unlike the adults and suggestive of the structure of less modified allied forms, as in the well-known examples of Ulex and Acacia. All such deserve careful study, and Dr. Diels has shown how they throw light on the value of "species," as in the forms of Limosella, and of "genera," as in the relation of Regnellidium to Marsilia. His discussion of the relations of certain species of Hakea, of Grevillea, and of numerous others, largely on the basis of his personal observa-

tions on the plants in their native habitats, is of great interest. The "larval" forms habitually passed through by certain plants, e.g., by *Veronica epacridea*, Actinostrobus, sps., and other conifers, various Leguminosæ, Eucalyptus, sps., Aloineæ, and members of other groups, are also discussed, and the conditions under which sexual reproduction may occur in plants that retain their larval aspect are investigated. That such plants have been described and named as distinct from the usual adult forms is well known, and this is seen to have been the case in Eucalyptus and in other groups.

A chapter on the phylogenetic significance of helicomorphy sums up the conclusions of the author. Many of the forms he regards as adaptations to environment, some of which are unstable, while others show the influence of heredity and persist under new conditions, e.g., the formation of phyllodes by Acacias in greenhouses. Some appear to become relatively constant in a short time, e.g., seasonal dimorphism of *Euphrasia Rostkoviana* and *E. montana*, believed by Wettstein to have become fixed as the result of the alpine meadows being mowed, and now retained in cultivation in a botanic garden. But, while there may in some be a strong hereditary tendency to repetition of the cycle, Diels concludes that each helicomorphic stage may be the starting-point of a new phylogeny. He emphatically opposes the belief that the helicomorphy of the immature plant necessarily represents a condition similar to that of the ancestors, and asserts that the apparently ancestral form has in many cases been acquired in response to the environments of the young plant. *Acacia insolita* is quoted as an example of a species descended from phyllode-bearers that now habitually produces pinnate leaves abundantly when mature, and the position is briefly stated thus:—"We saw that Phylloglossum resembles the young of many species of Lycopodium. But Lycopodium does not for that reason follow Phylloglossum in phylogeny, Phylloglossum may just as well be younger than the greater number of the Lycopods." The assumption that the infantile form must in all circumstances represent an older stage of ancestry than does the adult is frequently in opposition to the facts. A brief review of similar phenomena in the animal world, and a short bibliography, conclude the book. It only remains to add that the illustrations are excellent, and that a good index makes reference easy to the stores of information.

THE RADIO-ACTIVE PEDIGREE.

Radio-active Transformations. By Prof. E. Rutherford, F.R.S. Pp. 287. (London: Constable and Co., Ltd., 1906.) Price 16s. net.

THIS work is, in the main, a reproduction of Prof. Rutherford's Silliman lectures, delivered at Yale in March, 1905, and represents his latest views on the subject. Some treatment of radio-activity in general is given, and then a detailed development of the special subject of the book. This treatment differs only from the author's previous expositions in the greater detail in which the subject is worked out. Every month seems now to bring to light some hitherto unrecognised stage in the transformation of one of the radio-elements. One would suppose, however, that this field of discovery cannot be of unlimited extent, and that the full detail of the transformations must, before long, be made out, so far at least as they are accompanied by demonstrable radio-activity.

It has been usually assumed that each radio-active atom throws off an α particle, and becomes thereby transformed into an atom of a new product. On this view, it can be seen, with a little thought, that a mineral in radio-active equilibrium ought to owe an equal proportion of its activity to each of the products of a series, and there is considerable evidence that it is often so. Lately, however, two cases have presented themselves which seem clearly inconsistent with this. One of them, that of actinium, is mentioned by Prof. Rutherford in the present work. It seems that actinium, like radium, is found in uranium minerals, and in those only. Further, that the amount of actinium is probably, as the amount of radium is certainly, proportional to the uranium content. If so, we cannot but conclude that actinium is a member of the uranium series. Now comes the difficulty. Actinium certainly does *not* contribute anything like so much to the total activity of pitchblende as radium and uranium each do.

The second case is to be found in a paper in the October *Philosophical Magazine*. Moore and Schlundt have found that uranium X, the immediate product of uranium, gives a small α radiation as well as the β radiation by which it is mainly characterised. It is certain, however, that the α radiation of uranium is not much diminished by removing all the uranium X from it, hence the α radiation of uranium X must be comparatively small. Here again the principle of equal activity in each successive product of a series is violated. This latter case has only been brought to light since the publication of the present work, and quite a new light has been shed on the case of actinium by Dr. Boltwood's letter to NATURE describing the formation of radium from actinium. This seems to make it certain that actinium is in the main line of radio-active descent, and to put out of court Rutherford's plausible suggestion that it is the head of a collateral family. The subject, indeed, progresses so fast that the reviewer of a book like this almost always has lights which were not available to the author at the time of going to press.

The subject of the possible ultimate production of lead by the radium series is here discussed in some detail. It is doubtful, I think, whether much stress should be laid on the almost invariable presence of lead in uranium-radium minerals. An interesting spectroscopic investigation by Hartley and Ramage (*Engineering*, September 24, 1897) proved that lead was present in almost every one of a very large collection of iron ores examined by them. We cannot suspect a change akin to radio-activity in this case, for lead has a much larger atomic weight than iron,

and cannot be supposed to be a product of its disintegration

It is not necessary to dwell on the admirable lucidity and suggestiveness of Prof Rutherford's book, for that is no more than his readers have been taught to expect The only doubt which can be felt is whether it meets any want which was not already satisfied by his previous work, "Radio activity"

R J STRUTT

VISIBLE SPEECH

Lectures upon the Mechanism of Speech By Alexander Graham Bell Reprinted from the Proceedings of the First Summer Meeting of the American Association to Promote the Teaching of Speech to the Deaf, Pp 129 (New York and London Funk and Wagnall's Company, 1906) Price 1 00 dollar net

THIS interesting book consists of a series of lectures by Mr Alexander Graham Bell, whose name in the future may be as honourably associated with his labours in the education of deaf mutes as with the invention of the telephone His father, A Melville Bell, many years ago, devised a method of representing, or rather symbolising, positions of the vocal organs To this symbolic method he gave the name of "visible speech," because anyone acquainted with the symbols could place his vocal organs in the desired positions, and then, on emitting the breath and bringing the vocal cords into action, could produce the desired sound

"These symbols of visible speech," remarks Mr Bell, "bear the same relation to phonetics that chemical symbols do to the science of chemistry In dealing with the mechanism of speech, it is as necessary nowadays to make use of my father's symbols, as it is to use chemical symbols in treating of the composition of matter"

The symbols, which are very simple and ingenious, indicate the position of the lips, the position of the tongue, the condition of the larynx, and the condition of the passage between the larynx and the tongue or lips It is evident that to produce a given sound we might have a row of such symbols Thus, to sound the vowel *oo*, at least three position symbols would be required, and to show how to pronounce the word *moon* would require nine symbols, namely, three for *m*, three for *oo*, and three for *n* To avoid this difficulty the signs or symbols are abbreviated or condensed, so that the word *moon* is now represented by only three symbols, curious looking things, like old Gothic letters, but quite intelligible when one has, as it were, already studied their evolution The only comment I would make on the abbreviated symbols is that they should be printed on a fairly large scale, as a very slight mark may be of great importance, and a sharp eye is required if the symbols are printed small

Mr Bell then proceeds to show how the meaning of the symbols may be conveyed to the deaf They are exhibited on a large scale in a series of charts, and with infinite patience the teacher enables, by gestures and movements, the deaf mute to comprehend their meaning Step by step the pupil is taught how to place the lips, the tongue, the soft palate, and how to modify the form of the mouth The child has also explained how to produce various vowel sounds, which are divided by Mr. Bell into primary vowels, wide vowels, primary round vowels, and wide round vowels Each of these is accompanied by a symbol To show how much may be symbolised, take three of the primary round vowels, and we have symbols indicating (1) voice, back small aperture, lip small aperture, (2) voice, back mid aperture, lip mid aperture, (3) voice, back large aperture, lip large aperture

The teacher must have a feeling of great delight when he hears for the first time the required sound coming from the mouth of the deaf mute. Mr. Bell's criticism of methods is both wise and interesting, as we show by the following quotation —

"Now in teaching a deaf child you present to him a symbol for some difficult sound If he has been taught to analyse the symbols in the manner shown, the symbol conveys to his mind a direction what to do with his mouth That is what your pupil has to aim at, but in ninety nine cases out of a hundred he may not get it, at least at the first shot Now what are you going to do? Are you going to say, 'No, no! that's not right Try again'! Let him try once more, and the chances are that he fails again to give the sound intended The no-no method only aggravates the difficulty by discouraging the pupil and disgusting him with articulation The deaf child must know *what he did when he failed* The knowledge of that realism will guide him in his next attempt For example —If he knows that his tongue was too far forward in the mouth, in his next attempt he aims at having his tongue further back, and probably gets too far in that direction If, then, he is told the result of this attempt also, he makes due allowance the next time he tries He may fail a hundred times Now the position may be a little too far forward, now a little too far back, or the tongue may be too high or too low, but his knowledge of the effect of each effort causes him to approach more and more closely to the exact position desired, till at last he gets it, The time spent in studying and representing the incorrect positions is not wasted, for it gives the pupil mastery over the instrument of speech itself, and the struggle to get exactitude of position with one difficult sound gives him power to get any other, just as the ability to hit one bull's-eye qualifies a man to shoot at any mark" (p 70).

These wise remarks apply to many methods of practical instruction, in the laboratory and elsewhere Mr. Bell's lectures were delivered to teachers of deaf mutes, and often at the close of a lecture Mr. Bell was interrogated This Socratic method drew from the teacher many valuable remarks, and sometimes "asides," which showed the fertility of the lecturer's thought Altogether this little book is full of interest to students of phonetics, a department of science often a wilderness of dreary discussion, but here, in the hands of Mr Bell, a subject of living interest. To be able to teach deaf mutes how to communicate with their fellow mortals is an achievement worthy of one who has, in another province, made his mark on the technical science of the day

JOHN G McKENDRICK

THE GEOLOGY OF ARMENIA

A Treatise on the Geology of Armenia. By Dr Felix Oswald. Pp vii+516 (Iona, Beeston, Notts.: Published by the Author, 1906.) Price 1l 1s net.

THIS is a remarkable book from the point of view of the mere collector, and, in all seriousness, libraries should hasten to secure it. It has been hand-printed by the author, page by page, almost in the Caxtonian manner, and we are informed in a manuscript note that only 100 copies exist. That it was printed at all is due in the first instance to the rather stringent requirements of the University of London, to which it was presented as a thesis. It served its purpose there, but obviously deserved a wider circulation. It now appears with numerous hand-printed and hand-coloured geological sections, and some expressive, but not equally necessary, plates of fossils. The result is a book which is typographically a pleasure to read, each page being firmly printed in letters which are really black, and the hard travelling which lies at the back of its production is almost equalled by the subsequent and skilful industry of the author.

Dr Oswald's work should stand on shelves of reference beside Mr H. F. B. Lynch's fine volumes on Armenia, since the geological observations on which it is based were made when the two authors travelled together through a region of immense geographical and historic interest. About half the book describes Dr Oswald's own original results, and the remainder contains a valuable review of what has been previously written on the geology of Armenia. It is clear that we have here an unusually full work of reference, and the author-compositor has not shrunk from completing it by an index of sixteen pages.

The mountain-folding that determines the structure of Armenia (p. 9) seems to have occurred in Lower Permian, ante-Tithonian, and post-Oligocene epochs. The pressure in each case came from the south—Dr Oswald writes "resultant pressure," which we presume refers to the resultant of various forces within the crust. "The northern limit to all this mountain-folding was formed by the great granitic '*horst*' of the Meschic Mountains." The Caucasus is held to owe its present development to post-Miocene pressure from the north-east, which broke up the Armenian sediments into blocks. While Prof. Penck in a recent publication prefers to regard such blocks as the result of vertical forces, Dr Oswald sees in them (p. 10) "as much an expression of the tangential stresses in the earth's crust as the folds of the Caucasus itself." The volcanoes of Armenia have arisen along the post-Miocene lines of fracture, and the larger ones occur at points of intersection.

The most striking contribution of the author to our geological knowledge is the account of the Nimrud volcano (chapter ix.), the first survey of which was made by him and Mr Lynch in 1898. We all may be grateful to the Vali of Bitlis, who caused fifty soldiers to encamp in the crater in order to keep off bandits during these scientific investigations. The crater is five miles across, and its rim rises four thousand feet above Lake Van. The account of its structure and petrography is thus by itself no mean achievement.

The existence of Mr Lynch's book has left the present author little scope for picturesque description, but one landscape at least (p. 252) is brought vividly before us, where the broad dioritic downs of Kazikly Dagh end suddenly in "precipices seamed by torrents," and the country drops 5000 feet in four miles to the Meiriman Dereh.

Dr Oswald's review of preceding literature contains many useful criticisms and suggestions (pp. 355 and 356, for example). The book is not intended to be read from cover to cover as a narrative of travel, but it should obviously be made accessible to all future travellers in Armenia. G. A. J. C.

OUR BOOK SHELF

Position-line Star Tables for Fixing Ship's Position by Reduction to Meridian and Prime Vertical without Logarithmic Calculation. By H. B. Goodwin, R.N. Pp. xiv+96. (London: J. D. Potter, 1906.)

THERE are several tables in use which will enable a mariner to derive the correct meridian altitude of an object when the altitude near the meridian is known. Mr H. B. Goodwin has constructed tables which will give a correction of a similar character to obtain from observed altitudes near the prime vertical the correct altitude on that circle. If the object does not cross the prime vertical, the author employs the circle of maximum azimuth. The tables are not general, but refer to certain bright stars, eleven in the northern and six in the southern hemisphere. Seeing that some of the declinations fall very close together, as those of α Andromedæ, Pollux, α Coronæ, &c., there might have been some advantage in computing the tables for regular intervals of declination rather than for selected stars.

It is not difficult to derive a system of corrections which give the corrected altitude on the prime vertical, but are such tables necessary? The problem is to derive most readily the hour angle from an observed altitude of a known object in a given latitude. The advantage of referring the object to the prime vertical is not equally apparent, but the object of the author in a great measure is to avoid logarithmic calculation. This he has effected, and his arrangement is apparently convenient and sound from the analytical point of view. But if the suppression of logs is to necessitate such multiplication as 303.2×2.97 and 418.4×3.23 (numbers taken from the examples given), it is hard to see what improvement has been made.

We have worked out some of the examples both by means of these tables and also by solving the ordinary triangle ZPS. We have no hesitation in preferring the old-fashioned method. But we admit it requires great familiarity with tables before their full value is appreciated, and possibly anyone who has given the same amount of study to these tables that the writer has been obliged to give to logs would prove the superiority of Mr Goodwin's tables. But some people seem positively mad on tables. Would any sane man or anyone who could work such a sum in decimals as that just quoted, use a table for converting seconds of time to the decimals of a minute? Yet such a table is given here, evidently with the idea that someone would use it to find out that 24 seconds was equal

to 0·4 of a minute. We suspect that Mr. Goodwin knows a good deal more about the capacity of the men for whom he is writing than we do.

W. F. P.

The Horticultural Note Book. Compiled by J. C. Newsham. Pp. xx+418. (London: Crosby Lockwood and Son, 1906.) Price 7s. 6d. net.

THE contents of this book are as disconnected as are the words in a dictionary. Anything like a "review" is, therefore, out of the question. We can only state the general nature of its contents and give an opinion as to the way in which the compiler has accomplished his task. As to its contents, they comprise "practical rules, data, and tables for the use of students, gardeners, nurserymen, and others interested in flower, fruit, and vegetable culture, or in the laying out and management of gardens."

This is a fairly comprehensive enumeration, but it is not complete, for we also find various tables which will be of service to those who have to deal with woodcraft or the sale of timber. The compiler has done his work well, he is evidently familiar with the ordinary requirements of his readers, and he has fulfilled them with judgment and accuracy.

With such a mass of detail to deal with it would be wonderful if misprints did not occur, but they are remarkably few. On p. 299 there is, however, a crop of such blemishes which should be removed in a future edition. We may suggest also that the tables on pp. 251, 252 be expunged as inadequate and in point of accuracy not equal to the rest of the volume. We are glad to see various metrical tables added. No one who compares the regular definite proportions of the metrical system with the confusion of the ordinary lineal and land measures, to take one instance, can doubt the advantages of regular system over chaos. It is permissible to envy the next generation, whose labours will be so materially lightened by the general adoption of the new system.

The author has given not a few "miscellaneous" weights and measures, but he might have added more from the Covent Garden repertory, where cabbages are sold by the "mat," carrots by the "pad," cauliflowers by the "tally," to say nothing of "bundles," "bunches," "cases," and other indeterminate measures. A book of this kind is intended for reference purposes, and its value must be tested by frequent consultation. Tried by this test, we may say that we have found the book very serviceable. In a future edition a list of the commoner fungi and the plants on which they are parasitic would be desirable, for instance, we find no reference either to the ordinary or the American mildew attacking gooseberries, or to the fungous pests which commit such havoc with grapes, tomatoes, and cucumbers.

Funzioni poliedriche e modulari. By G. Vivanti. Pp. viii+437. Manuali Hoepli, 366-367. (Milano: Ulrico Hoepli, 1906.) Price 3 lire.

THE author tells us in his preface that he found Klein's "Vorlesungen über das Ikosaeder" and Klein and Fricke's "Theorie der elliptischen Modulfunctionen" "pretty stiff reading." Probably most students will sympathise with him and will give a ready welcome to this little book, which is intended to prepare the reader for the study of these classical treatises. The ground covered is approximately that of the last four chapters of Forsyth's "Theory of Functions" (excluding automorphism), but the subject-matter is discussed in much greater detail. The first part of the book deals with groups formed by substitutions of the form $z' = (\alpha z+\beta) \div (\gamma z+\delta)$, especially with the five finite (polyhedral) types of group and with the infinite (modular) group in which α, β, γ, δ are integers such that $\alpha\delta - \beta\gamma = 1$. In the first few pages a group is defined and some of its more elementary properties proved. It must be confessed that these introductory sections are not quite satisfactory, and it is doubtful whether they would be readily intelligible to anyone who had no previous knowledge of group-theory. For instance, the author fails to make clear the distinction between a group and a semi-group, or that between an abstract group and the particular application he has in mind. The rest of part i. is, however, clear and readable, and should serve effectively the purpose intended by the author.

In the second half of the treatise the author discusses the invariants of the polyhedral and modular groups, the connection of the Schwarzian equation with polyhedral and modular equations, and the application of the polyhedral groups to the solution of algebraic equations. This part appeals to a very different class of readers, in fact, the author assumes a knowledge of elliptic functions, Riemann's surfaces, the existence theorem, Noether's curve, the Galois field theory, &c. The lack of balance between the two parts in this respect is unfortunate, if unavoidable. There are a few errors, for instance, the statement of § 104 seems to require modification when $n=6$, while on pp. 208 and 209 the difference between (n), $[n]$ and $\{n\}$ is not at all clear.

Hermann von Helmholtz. By Leo Koenigsberger. Translated by Frances A. Welby, with a preface by Lord Kelvin. Pp. xvii+440. (Oxford: Clarendon Press, 1906.) Price 16s. net.

THE German original of this book appeared in 1903, and was reviewed at some length in NATURE of July 2 in the same year (vol. lxviii., p. 193). The work of translation is admirably done in every way, and the English public owes a debt of gratitude to the translator for enabling it to study in its own language one of the most interesting careers of the nineteenth century. A moderate all-round scientific training is necessary and sufficient to enable the reader to follow the description of the greater part of Helmholtz's work, but, though mathematical symbols are avoided, probably no one who has not specialised to some extent in applied mathematics will find intelligible the account of his more abstruse mathematical researches.

Though Herr Koenigsberger makes the very most of the space at his disposal, yet the reader lays aside a book of 440 pages with a feeling that he has seen the merest sketch of Helmholtz's life. Probably no better comment could be made on the industry of the great man of science or on the versatility of his genius. To do full justice to his career a treatise of three times the length would perhaps be needed. As it is, the reader is bewildered at the rapidity with which his attention is turned from one epoch-making discovery to another, and tries in vain to follow the steps by which Helmholtz was led from one subject to another when, during the space of three years largely occupied with his professorial duties, he discussed in turn optics, nerve transmission, acoustics, hydrodynamics, geometry, electricity, hay-fever, and so on.

Though, on the whole, the book lays more stress on Helmholtz's work than on the details of personal interest, yet the author has a true instinct for recording just those incidents of Helmholtz's life which throw most light on his character and ideals, and reveal most clearly the influences which surrounded him. We lay down the book with a feeling of very real sympathy for the frequent illness and bereavement which cast a perpetual shadow over the plea-

sures of a happy home and world-wide reputation, while we are conscious of a genuine admiration for the firm resolve to "make the most of his time" and to keep perpetually before him the remembrance of "how injurious megalomania may be for a student"

H H

Illustriertes Handbuch der Laubholzkunde By C K Schneider Pts iii and v (Jena Gustav Fischer, 1906) Price 4 marks each

THE general plan of this handbook or trees cultivated in Europe was explained in the notice of the first two parts that appeared in NATURE, November 24, 1904. The third part was issued early last year, and the fifth part—somewhat enlarged—completes the first volume

The third part contains the final portion of the Berberidaceæ, the orders Menispermaceæ to Crassulaceæ, and part of the Saxifragaceæ, the largest genera being Berberis, Mahonia, Magnolia, and Ribes. The Drupaceæ and Pomaceæ, generally regarded as suborders of the Rosaceæ, here treated as orders form the subject of the fifth part Prunus, Padus Pyrus, Sorbus, and Cratægus are large and difficult genera

It becomes more apparent that Dr Schneider favours subdivision, for, in addition to the suborders mentioned, subgenera such as Chænomeles are raised to generic rank, and some of the species would certainly be regarded by other authorities as varieties, also it is noticeable that the author does not confine himself to trees in cultivation The book thus becomes more of a dictionary and less of a practical manual, but due credit must be given to the author for the enormous amount of energy expended, and for the searching and critical investigation of specimens that has been accomplished The advantage of the rules laid down at Vienna last year becomes evident from the list of changes noted in the supplement

Old-fashioned Flowers and other Open-air Essays By Maurice Maeterlinck Translated by A Teixeira de Mattos With illustrations by G S Elgood Pp viii+115 (London George Allen 1906) Price 3s 6d net

PUBLISHERS have to cater for readers of various tastes, and so we suppose there are some to whom the present little book will appeal For ourselves we can but wonder that anybody thought it worth translating The text is mostly purely rhapsodical, reminding us of Ruskin at his worst There is very little said about flowers as flowers, and the moral and philosophical reflections present no striking novelty The illustrations are attractive but over-coloured, and probably do not do justice to the artist's original drawings

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The January Meteors

THE January meteors are seldom visible in England under favourable aspects, the weather being often adverse at this season Moonlight will partly veil the display in 1907 and the best times to look for it will be on the evenings of January 3 and 4 during the two or three hours preceding moonrise

The shower is sometimes as rich as an ordinary return of Perseids, and it always furnishes some bright, long meteors of an unusually conspicuous character We have gathered a large number of double observations of Perseids and Leonids, and know their average heights very well, but very few real paths of the January Bootids (or Quadrantids) have ever been computed It is desirable, therefore, that observers who are fortunate enough to notice any members of the latter shower should record their apparent paths with the greatest accuracy which the circumstances allow, with the view of finding their heights and radiants

The position of the radiant point has been already well determined at 230°+53°, and it is not probable that we shall ascertain it more precisely until photography can effectively take the place of the eye in meteoric observation

W F DENNING

Stereoscopic Lantern Slides

PROBABLY many people who have taken interest in stereoscopic photography at one time or another have regretted that there should be no simple means for showing the effect to a large audience

As a matter of fact this can be done very easily in either of two ways A stereoscopic lantern slide is first made by photographing an ordinary stereoscopic pair of pictures This pair of pictures is then projected upon the screen with an ordinary lantern The stereoscopic effect is obtained by using either a mirror stereoscope or a prism stereoscope The former consists of two small pieces of mirror held one in front of each eye The observer has the screen not in front of him but on one side, say about 60° from the direction in which he is facing

In each mirror the pair of pictures is seen and by tilting one mirror with respect to the other so that the two outside images are superposed the picture suddenly leaps into relief Of course if the wrong pair be superposed the familiar inverted relief will appear It is easy to mount the mirrors in a sort of spectacle frame one of them being fixed and the other capable of rotation about a vertical axis

It would not be difficult to explain to an audience of average intelligence the method of using such spectacles the spectacles could be made at a very small cost and the beauty of the effect would appeal to many

Cases frequently arise in university lectures in which a stereoscopic presentation of slides would greatly simplify explanations *e g* in biology

The other method is to use a single small achromatic prism, which is held in front of one eye the refracting angle being vertical and directed towards the other eye Of course prisms of different angles are required for different distances but a single prism can be made to suffice for a large range by twisting it about a vertical axis without greatly impairing the "stereoscopism"

At first sight one might think that the effect could only be seen by observers situate in or near a plane bisecting the screen at right angles but this is not the case Indeed, anyone who has worked with stereoscopic photographs must have been struck with the ease with which the eyes will adjust themselves to pictures which are not correctly aligned and experiment also shows that the two pictures need not be of the same size

G A SHAKESPEAR

The University, Birmingham December 17

Emerald Green Sky Colour

WHILE on a short stay at St Moritz I was much struck by the peculiar colour of the sky on the evening of December 10 It had been threatening snow most of the day and a few flakes fell during the afternoon, the sky being overcast At about 3 30 p m to 4 p m the sky cleared over the mountains towards the east and revealed instead of the usual blue, a fairly large expanse of vivid emerald green None of us had ever seen it before so that we all stopped I should be much pleased if any of the readers of NATURE could give me some idea of the cause of this unusual phenomenon

J W NOLTE

Kurhaus Lenzerheide, St Moritz, December 18

THE FRENCH SAHARA

(1) M. FOUREAU has already told in a popular form the story of the expedition which he conducted with so much skill and success from the shores of the Mediterranean to the mouth of the Congo. Crossing the little known country of the Touaregs, making the circuit round Lake Chad, descending the Shira and Ubangi Rivers, he had ample opportunity for examining the French possessions in Africa and studying the prospects of their future development. During the six years that have elapsed since his return from this expedition he has been engaged in arranging and discussing the scientific results, some of which[1] are now presented to the public. The first and second fascicules give details of the astronomical and meteorological observations, with a description of the water systems, the topography of the district, and the geological action of local winds. It is fortunate that the atlas of maps, which are drawn on a very elaborate scale, accompanies these handsome volumes. Since the geography of this part of Africa is somewhat uncertain, these are necessary in order to follow the exact route taken by the expedition.

M. Foureau is well known as an African explorer. For nearly thirty years he has traversed the Sahara in all directions, but his ambition to penetrate to the Sudan has always been foiled by the action of the Touaregs. In his many expeditions he has naturally been assisted by the Government and by learned societies, but he has never had at his command a force sufficient to overawe this warlike tribe and to make himself independent of its assistance or good will. In 1898 by a fortunate accident he found himself placed in a more hopeful position. Through a legacy from M. Renoust des Orgeries to the Société de Géographie a considerable sum of money became available for the purposes of exploration. The object of this bequest was to assist such expeditions as were undertaken with the view of bringing the independent tribes in the interior of Africa under the influence or protection of France, and which should by pacific measures tend to weld into a homogeneous whole the French possessions extending from Algeria to the Senegal and Congo. These funds were placed at the disposition of M. Foureau, who found himself in the autumn of 1898 at Wargla at the head of a small army of some 300 men, a thousand camels, and the usual equipment of a well-organised expedition. M. Lamy, of the army of Algeria, was associated in the command of the expedition, and had charge of the military dispositions. Unfortunately this energetic officer and able colleague, whose very ready assistance is warmly acknowledged, lost his life in an encounter with the natives.

The astronomical observations would perhaps be more fittingly described as geodetical, since they are naturally limited to the determination of the position of stations. The observations were made by M. Foureau and Lieut. Chambrun. For his longitudes the former relied mainly on the methods used at sea, supplemented by a few occultations and phenomena of Jupiter's satellites. The author carried four available chronometers, and remarks that the error in longitude arising from the accumulated error in the rate of the chronometers during 102 days amounts to only seven minutes of arc. It is not quite clear how this seven minutes is reckoned, but it certainly implies excellent performance of the watches and great care in their manipulation. It should be added, too, that wherever a comparison between the longitudes derived by different methods is possible, the agreement is quite satisfactory. M. Chambrun trusted to equal altitudes of moon and stars, and transits of the moon across the meridian. The latter, like some of the lunar distances taken by M. Foureau, were not found to possess sufficient accuracy. For latitudes both observers measured the altitude of Polaris and meridian altitudes of sun and stars. These results call for no remark, though it is impossible not to admire the energy which enabled these observers to prosecute their work after the fatigues of hard travel. M. Foureau also made some measures of the magnetic declination and horizontal force.

The meteorological or climatic observations are particularly welcome. These observations are of course spread over a large area, and it is not the climate of any one district that is presented. Concerning temperature, the author remarks that the thermometer fell below zero (C.) twenty-five times, the minimum reading being −10°.2 (14° F.) at a height of 1144 metres. The highest temperature experienced was 48°.3 (119° F.) in March, 1900. Throughout the region the minimum temperature occurs about 5 a.m., and the maximum between 1 and 3 p.m. During the 645 days on which observations were possible the sky was entirely free from cloud on 132 days, slight cloud was noticed on 227, while the sky was more or less overcast on 286. Dew was noticed on fourteen occasions, and rain fell on 116 days, but of these only forty-six were marked by severe storms; but violent atmospheric effects, whether of wind or lightning or sandstorms, were of frequent occurrence. In the Aïr highlands, almost every afternoon the sky was blackened, while violent thunder and lightning were experienced. The entire horizon would be continuously illuminated during whole minutes by brilliant flashes of lightning. Sudden hurricanes and appalling outbursts would keep men and animals in a state of tense excitement. Slight friction on the manes and tails of horses would bring forth, not electric sparks merely, but "des nappes de lumière."

The description of the Grand Erg and the character of the country through which the expedition passed,

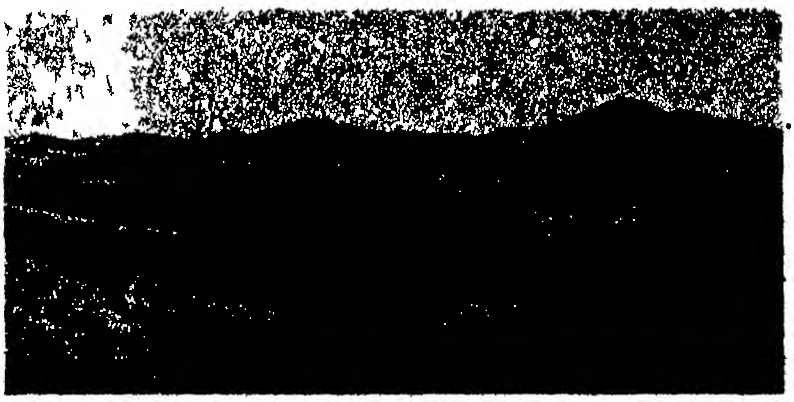


FIG. 1.—Large sand dunes in the Erg region, Sahara.

[1] "Documents scientifiques de la Mission saharienne (Mission Foureau-Lamy d'Alger au Congo par le Tchad)." By F. Foureau. (1) Parts i. and ii. Observations astronomiques et météorologiques. Pp. iv+551. (2) Part iii. Pp. 555–1210, with an atlas containing 16 maps. Geology, Petrography, Palæontology, &c. (Paris: Masson and Co., 1903–1905.)

its plateaux, its mountains, its profile, are all well brought before us; the illustrations are admirably reproduced, and the maps and plates make the text clear. Naturally M. Foureau had ample opportunity for studying the effect of wind erosion. On the Sahara its work is patent. The great variation in temperature by day and night brings about a constant cracking and crumbling of rocky corners, grinding each other into smaller fragments, which are ever being blown about by winds powerful enough to whirl along lumps of stone like feathers. Thus the constant manufacture of sand goes on, the friction of the particles of which gives to hard, compact rocks a polish like that of the lapidary's wheel. Other rocks of unequal consistency yield irregularly. The author traces the effects on various kinds of rock, granites and sandstone, and shows the fret and honeycombing that follow. Having produced the sand by hard wear and tear it is comparatively easy to construct the dunes, so conspicuous a feature on the comparatively level plains of the Sahara. Wherever obstructions intervene, such as prominent rocks, bushes, inequalities in the distribution of sand level, a steep talus of grains gathers in the sheltered lee, while a more gentle sloping bank gradually rises on the windward side of the obstruction until this is finally buried. The weird shapes into which this sand is blown, the strange curves it assumes, seem to be in many parts of the Grand Erg the only variation in a desolate landscape (Fig. 1). The author's description of Lake Chad is very interesting. This lake has about it something mysterious, and it is much to be regretted that the examination was not more thorough, with the view of unravelling what is obscure. To picture the lake as a compact sheet of water is quite inadequate. Whether the lake may be considered as containing an archipelago, or whether it runs away into numerous lagoons, creeks, swampy stretches, disconnected from the main body, is not yet cleared up. Whether these detached patches of water were originally parts of the lake and now represent the deepest portions of the original bed, indicating that the lake is gradually disappearing, is one of those problems upon which more information is required. In these detached lakelets the water is brackish, but in the main body of the lake the water is fresh. The author raises the point whether some of these separate lagoons are not fed by subterranean water, which might explain the presence of salt. Where communication with the lake is probable or suspected there is very little salt in the water, but where the two are clearly distinct the presence of salt is very pronounced in the smaller body. M. Foureau directs attention to some very interesting points concerning the currents in this lake or in extensions of it, and discusses whether these currents are due to wind or evaporation; but into this, as into many other important points examined in these volumes, we have not space to enter.

W. E. P.

(2) Now that so much new light has been thrown on North African geology by the explorations in the Lake region in the east on the one hand, and in the territories of Germany, France, Great Britain, and the Congo Free State in the west, the largest of the unexplored tracts left of the once "Dark Continent" is that of the French Sahara lying between Algeria on the north and the Congo territories on the south. Of this vast area a preliminary survey has been accomplished by the Mission Foureau-Lamy, which, setting out from Algeria in November 1898, reached the Congo by way of Lake Chad in July 1900. Ample collections were made along this almost unknown route, and detailed observations recorded on the topography, hydrology, and geology of the countries on the line of march. The results of the examination of the botanical, zoological, geological, and ethnological specimens in the light of observations made during the journey are now published by the Geographical Society of France, with the aid of subventions made by the French Government, the Academy, and the French Association for the Advancement of Science. Needless to say, the work before us (part iii.) has been issued in a form worthy of the highest traditions of French science, and with a great wealth of valuable illustrations.

Fig. 2.—Weathered pegmatite, showing the appearance of rock masses in the Sahara.

In the geological notes made by the travellers along the line of route are found many very interesting observations on the mode of weathering of rocks in tropical districts. The illustrations reproduced are excellent examples of the action of sun and wind upon rocks in a desert region. The rocks passed over consist of granite, which appears to occupy a very large area, crystalline schists, and sporadic masses of various volcanic rocks, with representatives of Silurian, Devonian, Carboniferous, and Cretaceous formations. In addition to these there are sandstones of which the geological age could not be determined, and various superficial deposits.

The rock specimens were entrusted to M. L. Gentil, of the Sorbonne, a pupil of Prof. Lacroix, for description, and his report on the petrography of the regions traversed is a contribution of great value. Interesting laterites, diatomaceous earths, and travertines are among the most important of the materials of aqueous origin. The igneous rocks exhibit a great variety, and include, besides many varieties of granite, ophitic diabases, andesites, rhyolites, trachytes, phonolites, tephrites, and basalts. One very interesting feature exhibited by many of these rocks is their richness in the alkalies—the soda augites and hornblendes, like riebeckite, ægerine, &c., abounding in them. These facts, taken in conjunction with the studies by Mr. Prior, of the British Museum, on the rocks of the Lake district of Africa, of Prof. Bonney on those of Socotra, and of Prof. Lacroix in the Somali country and Madagascar, lend support to the view enunciated by the last-mentioned geologist that

a belt of alkaline igneous rocks surrounds the African continent

The extensive collections of fossils brought home by the members of the Foureau-Lamy mission were placed in the hands of the late Prof. Munier-Chalmas for description, and on the lamented death of that palæontologist were transferred to his successor, Prof. Émile Haug. Valuable assistance in the work of determining and describing these fossils was received from Profs. Zeiller and Douvillé and from M. and Madame Œhlert. The result of these studies is to show that, in addition to the granitic and metamorphic rocks which at present cover such wide areas in the French Sahara, fossiliferous strata belonging to the Silurian, Devonian, Carboniferous, and Cretaceous systems also occur.

At a place called Tindesset, about 764 miles due south from Philippeville, there is found a series of

FIG. 3.—The larger specimens illustrate the fine fretted patterns produced on the surfaces of limestone rocks by the continued action of impinging sand grains driven by the wind. The four smaller specimens (17, 18, 19 and 20) illustrate the wearing down of fragments of siliceous rock, acted on by the natural "sand blast." These are similar to those described by Mr. Enys from New Zealand.

shales cropping out from below the Devonian sandstones. The point at which they occur is nearly 4000 feet above the sea, and was reached with great difficulty by the members of the expedition. On splitting specimens of these shales that were brought home the late Prof. Munier-Chalmas found undoubted examples of graptolites belonging to the genus Climacograptus. At that time strata of Silurian age were not certainly known to exist in the Sahara or in any part of northern Africa, but subsequently M. Flamand described graptolite shales as occurring in the Sahara at a locality about 250 miles north-west of Tindesset. As these belong to the Llandovery (Gothlandian) stage, the fossils of Tindesset may not improbably be referred to the same age.

The Devonian strata cover a wide area in the northern part of the district traversed by the mission. Strata of this age were recognised by Overweg so far back as 1850, the fossils being determined by Beyrich. In the district of Tassili they form a plateau consisting of sandstones passing into quartzites. Besides the obscure fossils referred to, Spirophyton, Arthrophycus, Nereites, Crossopodia, Nemertites, and Medusina, undoubted examples of Homalonotus, Melocrinus, and various brachiopods occur, which justify the placing of these strata at the very base of the Devonian. In addition to these, a number of separate valves of a lamellibranch shell, mineralised by hæmatite, were found. These are referred by Munier-Chalmas to a new genus (Desertella), and the beds containing them are doubtfully assigned to the Middle Devonian.

The Carboniferous system, also first recognised in North Africa by Overweg and Beyrich, has been found at many points in the Algerian Sahara, and a fairly large series of fossils (principally plants and brachiopods) was brought back by the members of this mission. The strata of sandstone and limestone appear to rest quite conformably upon the Devonian sandstones, and to represent low horizons in the Carboniferous system (Oural̈ian and Moscovian). As is well known, Upper Carboniferous strata also occur over considerable areas in North Africa.

The Cretaceous strata consist of the widely-spread beds of limestones forming extensive plateaux, and containing *Ostrea columba* with other characteristic Cenomanian fossils. The escarpments formed by these limestone plateaux have a height of from 300 feet to 350 feet, and at their base it has long been known that variegated clays with beds of gypsum occur. Up to the time of the dispatch of the Foureau-Lamy mission, however, no fossils had been found in these beds, and their age remained doubtful. The discovery of the remains of Cretaceous types of Ceratodus with other fishes and some reptilian bones led Munier-Chalmas to assign these strata to the same age as our Gault.

In addition to the fossiliferous rocks referred to above, tracts of sandstone strata, which yielded no trace of fossils, were found, and the exact geological age of these must remain for the present in doubt.

Two plates of the work are devoted to illustrations of the structures developed in limestone rocks by æolian action—the impinging on rock-surfaces of sand grains driven by the wind. These are well known to all geologists who have studied desert formations, but the examples so beautifully figured in this work are of exceptional interest (see Fig. 3).

In the ethnographical section of this volume, which is very full and admirably illustrated, facts of very considerable geological interest are recorded. Most important of these is the account of the occurrence of implements formed of sandstone and quartzite, which are of undoubted Palæolithic types. The whole of the ten examples appear to be of the large, elongated, and pointed form so common at Saint-Acheul, none of the smaller oval type having been found. Neolithic types of both polished and unpolished implements abound, and are very fully illustrated.

Both the authors and publishers of this very important work are to be heartily congratulated on the discoveries made and the manner in which they are given to the world.

J. W. J.

SCIENTIFIC WORK ON MONT BLANC[1]

THE sixth volume of these reports upon the observations made in the highest experimental station in Europe contains an account of some valuable results obtained by the director, M Vallot, as to the respiratory changes associated with prolonged residence at the altitude of 4350 metres The observations were begun at Chamonix in 1886, this preliminary inquiry led to extended experiments with improved methods mainly in 1898, 1899, and 1900 The object of the inquiry was to ascertain the physiological condition, as regards respiratory efficiency, of an individual living for some little time in the observatory and carrying on his ordinary avocations Many observations were made by M Vallot upon himself, but these were supplemented by those obtained from a skilled collaborateur, M de Goumoens

It cannot be said that this prolonged and laborious inquiry presents that extent of scope which was such a characteristic feature of the work carried out by Prof Zuntz, but the results are in some respects quite as valuable as those of Zuntz and his colleagues, for, in the first place, they are trustworthy observations made during a prolonged sojourn at an altitude exceeding that of the Margherita Cabin on Monte Rosa, and, in the second place, the fact that they are confined to one narrow field gives them an additional scientific exactitude It is undoubtedly an advantage, in any study of the exceedingly complex changes which the living organism undergoes at high altitudes, to focus the attention upon one point of fundamental importance It is obvious that such a point is the total respiratory ventilation during a stay in high altitudes, for the modification of the respiratory acts is a familiar incident in the experience of all those who have had the opportunity of reaching the summit of the higher Alps Moreover, the detailed study of respiratory modification through diminished atmospheric pressure must be carried out before drawing any physiological conclusions as to the significance of those general metabolic changes which have been so ably brought forward by Zuntz There is consequently a distinct gain in the concentration of effort displayed by M Vallot It is possible that the technique employed by him might be now improved, each succeeding Alpine investigator of a scientific character learns something from a predecessor, and this truth is plainly displayed in the account given by Zuntz already referred to, and in the more recent memoirs of Durig published this year in vol cxiii of the *Archiv f d ges Physiol* But the methods used by M Vallot appear to be fully adequate to determine the special points which he brings forward, and the results undoubtedly reveal certain features of the respiratory mechanism of no little special and general interest

It is common knowledge that the degree of the pulmonary ventilation is continually changing, this being due to alterations both in the frequency and the amplitude of the respirations, but if the amount of the air breathed in and out is estimated during the whole of a considerable period, these variations practically disappear It is thus possible to obtain a series of total volumes of pulmonary ventilation, each number in the series being that of some given period, such as an hour, or a day of twenty-four hours The work described by M Vallot consists in framing such series, both for himself and for M de Goumoens, when resident in Chamonix, during a prolonged stay in the Mont Blanc Observatory, and again on return to the Chamonix level His observations have thus been made continuously for considerable periods, and each period has comprised the ascent to the observatory, residence there, and the return to Chamonix On comparing the observations made respectively first at the low level then at the high altitude, and finally at the low level again, certain differences are brought to light

In the first place, M Vallot shows that his method is adequate to display the diurnal variations in the total pulmonary ventilation which occur at ordinary levels independently of the muscular exercise, and which are undoubtedly related to food assimilation With regular meals and sound digestion these variations occurred in the results obtained in Paris, and in Chamonix, their general character was a series of rises in the total amount of the hourly ventilation, each rise came on after a meal, and lasted for a given period before it declined towards its old level These diurnal food variations in the pulmonary ventilation persist, according to M Vallot's observations, when the subject is living at a high altitude, and their character is unaltered provided the regimen of diet remains the same and there is no obvious impairment of the digestive system

The most important part of the observations is, however, that which contains a series of the daily ventilation aggregates In regard to these, M Vallot considers them from two standpoints — (1) that in which the aggregate volumes of the respiratory tidal air are measured at the temperature and pressure which they have in the lungs this he terms the "real ventilation", and (2) that in which the same aggregate volumes are all reduced to what they would be at 0° C and 760 mm Hg pressure— this he terms the "absolute ventilation" The "real ventilation" he takes as an index of the amount of the total thoracic enlargement, and thus of the mechanical work of respiration, whilst the "absolute ventilation" he takes as an index of the quantity of air and of its oxygen component introduced into the lungs for the purposes of the organism His general results may be briefly set forth under these two aspects

(1) *Changes in "Real Ventilation"* —All observations of an extended character on real ventilation quantities show in each individual occasional variations occurring irregularly, and not accounted for either by muscular movements or, apparently, by food These irregularities became far more conspicuous during prolonged residence in the observatory, and indicate that the organism when in elevated regions, is in a condition of greater instability as regards its body processes, with due caution M Vallot declines to give any more definite hint as to their meaning If these irregularities are put on one side, the mean level of a whole series of daily aggregates is seen to be considerably affected by the high altitude of 4350 metres The effect is a rise, which in M Vallot (regarded as a trained subject) was immediate on arrival at the observatory, it amounted to a total daily increase in "real ventilation" of 30 per cent over the Chamonix figures It was very slightly increased during the stay in the observatory, and immediately fell on descending again to the lower level It was not the consequence of the muscular efforts involved in the ascent, and appears to have been a direct response of the organism to the lower atmospheric pressure there is thus an increase in the mechanical work of the thorax and lungs at high altitudes

In the case of M de Goumoens who is described as an "untrained subject" this immediate rise in

[1] "Annales de l'Observatoire météorologique, physique et glaciaire, du Mont Blanc." Tome vi Pp vii+218 Publiées sous la direction de J Vallot, Fondateur et Directeur de l'Observatoire (Paris G Steinheil, 1905.)

ing to 45 per cent over the Chamonix figures, it was increased during the prolonged stay at the observatory, and on descending to Chamonix it only partially fell to the level of the ventilation before the ascent, an excess remaining for many weeks

(2) *Changes in "Absolute Ventilation"*—The importance of this series of calculations rests on the possibility of comparing these changes with those in the "real ventilation," for it will be clear that if the views advanced by M Vallot are sound, then such comparisons will indicate how far the augmentation in the "real" values through extra thoracic enlargement has sufficed to compensate for the diminution in the actual quantity of oxygen as the result of the diminished air pressure In the case of M Vallot who by frequent visits and ascents was a "trained subject," it appeared that the high altitude always caused on arrival at the observatory an immediate fall in the total value of the absolute ventilation, this fall, although not large, was quite distinct, so that the increased thoracic work was apparently insufficient to compensate fully for the diminution in the quantity of inspired oxygen caused by the lowered atmospheric pressure This continued for some days of the residence in the observatory, and then gradually became almost inappreciable, the deficiency being decreased by 50 per cent, indicating the gradual development of an acclimatisation compensation As in the real ventilation, so here the descent to Chamonix was necessarily associated with an immediate and complete return to the normal condition

The case of M de Goumoens is still more interesting because more marked He is spoken of as the "untrained" subject, and in his case the "absolute" value of the daily ventilation immediately fell considerably more than in the case of M Vallot This considerable fall occurred in spite of the circumstance that the compensatory thoracic work had shown a very marked increase The continued life in the observatory was in M de Goumoens's case associated with a much more notable adjustment of the absolute ventilation value than M Vallot (the "trained" subject) showed, so that by the second week the deficit had diminished by 80 per cent The descent to Chamonix was associated with the disappearance of the deficiency, but since the "real" value remained persistently increased, this caused the "absolute" value to be so much that instead of a deficiency there was now an excess of 30 per cent over the previous Chamonix figures Hence it appears that the respiratory mechanism responds by a compensatory increase, as regards mechanical work when the subject is brought into a low atmospheric pressure, that this response is immediate but is at this high altitude insufficient, and that the degree of insufficiency is less in those who have frequently undergone the experience A further compensatory increase is then gradually brought into play which adds to the total and makes the whole compensation more nearly adequate, but this does not as the immediate one does, cease when the subject returns to lower levels It would thus seem probable although M. Vallot does not himself give any definite suggestions on this point, that the immediate adjustment is one involving the respiratory nerve centres, whilst the slow adjustment involves the actual framework of the thorax

The total change in respiratory ventilation value, whether "real" or "absolute" being itself brought about by either greater amplitude or greater frequency of respiration, it was necessary for M Vallot to ascertain the share taken by each of these factors The changes in frequency were often very pronounced, but their periodicity and general character were so irregular that no direct relation between the real ventilation values and the frequencies could be ascertained. On the other hand, the results as regards amplitude were far more definite, and it would appear that this is the chief factor in the production of the compensatory effect. The details of the observations given by M Vallot under this head need not be referred to, since their general character will be sufficiently indicated by the foregoing remarks As regards the whole investigation, it will be evident that since several such series of experiments were undertaken, the researches described in this volume of the *Annales* indicate an immense amount of laborious and prolonged work, and M Vallot is to be congratulated upon the solidity of the contribution which he has made to the physiology of respiration, and upon the pertinacity which he has displayed in his conduct of the whole inquiry; this pertinacity, combined with a rigorous limitation of the inquiry to one issue, has resulted in genuine achievement

Two other short memoirs are bound up with the volume The first of these deals with meteorological observations made on the Glacier de Tête-Rousse by M Mougin and M Bernard during the following periods August 1 to October 15 1901; June 1 to October 10, 1902, and July 1 to October 13, 1903 The occurrence of rain snow, dew, &c, is noted, and the daily temperatures, minimal and maximal, are tabulated A series of special experiments was made as to the temperature of internal parts of the glacier It appears from those that at a depth of 15 metres the temperature remained constantly at 0° C throughout all the months of the year.

The third memoir is one by M Henri Vallot In this the author gives some further particulars as to the method which he has employed for mapping out the details of the Mont Blanc summit with its extensive glacier fields

F G

SUCCESS OF ANTI-MALARIAL MEASURES

TWO reports recently issued prove in a striking manner that malaria may be stamped out by the application of scientific measures directed against the malaria-bearing mosquitoes The first report deals with Ismailia[1] Malaria was introduced into Ismailia in 1877 and since 1886 nearly all the inhabitants have suffered from the disease In 1901, on the initiative of Prince Auguste d'Arenberg, president of the Suez Canal Co, Prof Ronald Ross was consulted, and, acting on his advice, a series of measures instituted which has had the welcome result of completely freeing Ismailia from malaria These measures consisted in the destruction of mosquitoes principally by filling in and draining the pools and marsh land, or treating these with petroleum where the Anopheles breed, concreting water courses, &c, and instructing the inhabitants and protecting their household water supplies. This has been attained at an initial cost of 50,000 francs, and an annual outlay of 18,300 francs.

These measures were commenced in 1903, and from that time the ordinary mosquitoes disappeared from Ismailia, so that mosquito nets are no longer necessary Since the autumn of that year not a single Anopheles larva has been found in the protected zone, and no fresh cases of malaria have occurred The number of cases of malaria per annum in Ismailia has been as high as 2500, and in 1902, before the

1 "Suppression du Paludisme à Ismailia." (Compagnie Universelle du Canal maritime de Suez, Paris, 1906.)

anti-malarial campaign, there were 1550! The report is illustrated with interesting plans and diagrams

At Port Swettenham, Federated Malay States, anti-malarial measures were commenced in 1901 and 1902, and the latest report,[1] by Drs Travers and Watson, shows how great a measure of success has been attained Among the Government employees, for example, in 1901 236 sick certificates were issued and 1026 days of leave were granted on account of malaria. In 1905 the figures were respectively four and thirty Comment is needless

[1] *Journ of Trop Med*, July 2

NOTES

At a special general meeting of the Royal Society of Edinburgh, held on December 21, the council presented a report on the new accommodation to be provided for the society in consequence of its proposed removal from the Royal Institution, under the provisions of the National Galleries (Scotland) Bill We learn from this report that in March last a memorial was presented to the Secretary for Scotland directing attention to the needs of the society, and asking for a free grant of 600*l* a year In a semi-official reply to this memorial the general secretary of the society was informed that a proposal was being entertained by the Government to devote the whole of the Royal Institution to the purposes of art, and that the Royal Society must contemplate the necessity for finding accommodation elsewhere As it appeared from correspondence and an interview with the Secretary for Scotland that the Government had definitely decided to allot the whole of the Royal Institution for the purposes of art, the council resolved with great reluctance, to accept the necessity for removal and to do its best to secure adequate reinstatement An accommodation committee was therefore appointed by the society to advise the Secretary for Scotland regarding sites and buildings suitable for new premises for the society, with the result that the committee unanimously recommended the building at present occupied by the Edinburgh Life Insurance Office, Nos 22 and 24 George Street At an interview on November 22 Mr Sinclair offered, subject to the consent of Parliament, to purchase and adapt the George Street building on certain conditions, and in addition to give a free grant for the scientific purposes of the society The conditions proposed were approved by the representatives of the society present as being, in the circumstances, an equitable settlement of the claims of the society In a letter received by the general secretary indicating the nature of the proposals which Mr Sinclair intended to make in committee on the Bill in question it was made clear that the society was to occupy the building on identical terms with those of the occupancy of the Royal Society at Burlington House In the speech of the Secretary for Scotland on December 13, during the debate in Committee of the House of Commons on the Galleries Bill, the final proposals regarding the accommodation and grant to the society, recorded in last week's NATURE (p 179) were described Briefly the arrangements are that a sum of 25,000*l* will be used for the purchase of a building, and 3000*l* to cover the expenses of fitting up, redecorating the new premises, and transferring the library and other effects of the society from the Royal Institution The Treasury will also give the society a grant of not more than 600*l* a year The council expresses the opinion that these proposals meet the claims of the Royal Society both in respect of an additional grant and of reinstatement in suitable new premises In conclusion, the council remarks in the report that the society owes a debt of gratitude to the Scottish Members of Parliament, to various members of the Royal Society of London and to the British Science Guild for their loyal support in a time of difficulty The report of the council was, on the motion of Sir William Turner, seconded by Prof. Bower, received, and unanimously approved by the society at the special meeting on December 21

The death is announced of Dr A W Panton, tutor and lecturer on mathematics at Trinity College Dublin Dr Panton made several useful contributions to mathematical science and was the author, in conjunction with his colleague, Prof W S Burnside of a standard work on "The Theory of Equations"

The *Petit Parisien* recently invited its readers to vote on the question of the relative preeminence of great Frenchmen of the nineteenth century The result is recorded in Monday's *Times* Fifteen million answers were received, and Pasteur's name headed the list with 1 338 425 votes, Victor Hugo in the second place being more than one hundred thousand votes behind him In addition to Pasteur the following is the order of the names of men of science who appear among the first twenty in the list — Prof Curie, Dr Roux, Parmentier, who introduced the potato into France, Ampère, Arago, and Chevreul, the chemist It is clear from the results of this *plébiscite* that the French people cherish the memories of the scientific investigators whose work has contributed, not only to national renown but also to the advancement of knowledge throughout the world

Reuter reports the following severe earthquake shocks during the past few days --*December 22 Kopal, Semirechensk* —An extremely violent earthquake shock lasting one and a half minutes was felt in this district at 11 20 p m *Rome* —The seismographic instruments at the observatories of Bologna and Florence recorded in the evening a violent earthquake estimated to have originated at a distance of 7000 kilometres *December 26, Santiago de Chile* —A strong shock of earthquake is reported from Arica Shocks were felt at Iquique and Pisagua

A Reuter message from Naples states that a portion of the crater of Vesuvius fell in on December 20, with the result that a shower of ash fell over Naples for twenty minutes so thickly as to obscure all view of the volcano Later in the day the ash ceased to fall at Naples, but continued in the direction of Portici and Pompeii

The St Petersburg correspondent of the *Globe* reports that an expedition for the exploration of the Arctic regions is being equipped under the leadership of Lieut -Colonel Sergeyeff The expedition will last for several years, and will start from Yeniseisk, and try to reach Bering Strait

In the September number of *Terrestrial Magnetism* Prof G B Rizzo states that on September 7 1905 some hours before the Calabrian earthquake of last year a land surveyor at Monteleone found the needle of his compass so much disturbed that he was compelled to discontinue work In Japan great earthquakes have been known for some time to be preceded by magnetic disturbances, but we are not aware that any of these have been so large as that recorded by Prof Rizzo

The annual conversazione of the Royal College of Science and Royal School of Mines Students' Union was held on December 19 at the College in Exhibition Road, South Kensington There were exhibits and demonstrations

in mining and metallurgy, mechanics, geology, botany and zoology, and the Solar Physics Observatory was thrown open for inspection Prof W Gowland gave an illustrated lecture on "Stonehenge," and two lantern lectures were given by Dr W J S Lockyer on "The Photography of Clouds and Lightning"

A TELEGRAPHIC message in the *Times* of December 17 announces that Prof Koch who has for some time been engaged in investigating the causes of sleeping sickness in German and British East Africa, has proved that atoxyl is an effectual remedy against the disease The treatment is reported to have been successful in all cases which have so far been dealt with and it now only remains to test the permanence of the cures effected If this news proves to be true, Prof Koch is to be congratulated on finding a cure for this deadly disease which has already spread over the Congo Free State, has depopulated some of the most fertile districts of Uganda and is threatening the Sudan on the north and Rhodesia on the south It is, however, probably somewhat premature to speak of cures in a chronic disease such as this, which may run without treatment for several years Nagana which is closely related to sleeping sickness is an acute disease in horses, killing them in three or four weeks By giving the animals arsenic however, they may be kept alive for a year or more If one must wait a year to test the permanence of a cure by arsenic in an acute disease such as nagana, how much longer must one wait in such a slow, chronic disease as sleeping sickness, which may have a natural duration of years instead of weeks? Prof Koch's preliminary report will be awaited with interest

THE annual meeting of the Association of Economic Biologists will be held at Cambridge on January 9, 10, and 11 The laboratories in the pathological department of the University and the zoological laboratory will be thrown open for the occasion On January 9 the president Mr F V Theobald, will deliver an address on sea fisheries The following papers will be read during the meeting —Red-water fever and allied diseases, Prof Nuttall, F R S , cereal breeding, H R Biffen , new hemipterous fruit pests in Britain F V Theobald, Intorno agli esperimenti contro la Mosca delle olive (*Dacus oleae* Rossi), Prof A Berlese, on the American gooseberry mildew, an epidemic fungus disease now invading Europe, E S Salmon, the successful extermination of the black currant gall-mite, W E Collinge, the geographical distribution, natural and artificial, of the principal rubber plants, W G Freeman, notes on insect pests in the British East African Protectorate, F V Theobald, the spruce gall and larch-blight diseases caused by "Chermes" and suggestions for their prevention, E R Burdon, a description of an infectious disease occurring in hares, T Strangeways, the blood changes in man caused by the presence of metazoan parasites, and their aid in diagnosis, E G Fearnsides, on the use of an economic museum in the teaching of geography, W G Freeman

A BILL has been deposited in Parliament to incorporate the Channel Tunnel Company, and to authorise the construction of works which shall form part of the scheme intended to connect England and France by means of a railway in tunnel under the English Channel It is estimated that the scheme will involve a total outlay of 16,000,000*l* Half that amount is to be raised in this country, and the remainder is promised in France as soon as the scheme shall have received Parliamentary sanction in England It is proposed to construct two parallel tunnels, the total length of which under the sea is to be twenty-four miles, and with the land approaches on either side thirty miles The tunnels, each 18 feet in internal diameter, are to be driven from Dover to Sangatte throughout the whole distance in the grey Rouen chalk Power for the electric motors which are to be employed in the tunnel traffic is to be obtained from large generating stations, which are likewise to supply the current required for lighting and the compressed air necessary for the purposes of ventilation

No 7 of vol xvi of the Proceedings of the Royal Physical Society of Edinburgh is devoted to the second part of Dr T Scott's catalogue of the crustaceans inhabiting the basin and estuary of the Forth, this portion dealing with the ostracods, copepods, and cirripedes

To the November number of the *American Naturalist* Prof H F Osborn contributes the first portion of an article on the causes of extinction of species in mammals more especially the larger kinds After referring to the views of Darwin, Wallace, and Lyell, the author discusses in turn the influence of changes in the shape of land-masses and their connections, of climatic changes, especially increasing cold and varying degrees of humidity, of changes in the flora of countries brought about by climatic alterations, and finally, the effects of insect-life The concluding portion of the paper must be awaited before a summary of the author's views can be given In another article Dr Raymond Pearl discusses variation in the number of seeds in the lotus, *Nelumbium luteum*, while in a third Messrs J A Cushman and W P Henderson give the results of a preliminary study of the finer structure of the "test" of the fresh water rhizopod Arcella

IN the November issue of the *Quarterly Journal of Microscopical Science* Dr Georgina Sweet continues her account of the anatomy of the marsupial mole (*Notoryctes typhlops*), dealing in this instance with the vestigial eye This organ, despite the fact that its owner spends much of its time on or near the surface of the ground, is much more completely atrophied than in the mole the optic nerve and lens being wanting, while the other structures connected with vision are degenerated in a greater or less degree The eye itself has sunk deep beneath the skin which passes over it unaltered except for the presence of sensory (? tactile) organs developed from the lachrymo-nasal glands and ducts This complete degeneration of the eye may be attributed to the irritating effects of the particles of heated sand amid which the creature dwells, the development of the glandular structures into sense-organs being in all probability a compensation for the loss of vision

AMONG other articles in the November issue of the *Quarterly Journal of Microscopical Science*, one, by Mr F A Potts, is devoted to the modification in the sexual characters of hermit-crabs induced by the parasitic cirripede Peltogaster Two articles, one by Mr E Potts, of Philadelphia, and the other by Mr E A Browne, of University College, London, treat specially of the medusæ of the American fresh-water polyp Microhydra with notes on the two other known forms of medusa-producing polyps In a fourth article Mr C Shearer describes the structure of the nephridea of the annelid Dinophilus, which proved to be closed internally by "flame-cells," or "solenocytes," similar to those of certain polychæte annelids, the lancelet, and one form of the Phoronis larva The two remaining articles deal respectively with the canker of apple trees and Dr R Goldschmidt's recent monograph on the lancelets of the genus Amphioxides

THE report of the Board of Health on Plague in New South Wales in 1905 includes reports on the fifth outbreak of plague at Sydney, by Dr Ashburton Thompson, on outbreaks of plague on the Clarence and Richmond Rivers, by Mr R. J Millard, on an outbreak of plague at Newcastle, by Mr R Dick and appendices on the kind of printed forms used in investigating plague and on the epidemiology of plague, the latter being an address by Dr Thompson Again clear evidence is brought forward of the correlation between rat plague and human plague in the four localities of the outbreaks, and Dr Thompson's address gives a valuable summary of the epidemiology of the disease The report is illustrated with five maps and a chart

THE last Bulletin of the Madras Museum, under the editorship of Mr E Thurston contains an interesting monograph on the Paraiyan or Pariahs of southern India The name of this caste seems to mean "drummers" and the Rev A C Clayton, the author of the monograph accepts the theory that they are a people who in former times were priests of the non-Aryan or Dravidian races and that the detestation shown by the Brahmans to them is based on religious rivalry rather than on their foul course of life—the eating of carrion and the like Mr Clayton gives an interesting account of their religious rites, social and domestic ceremonies These have clearly suffered much modification under the influence of their Hindu neighbours, and they now retain little that is really primitive Thus they seem to have discarded the totemistic exogamous system of groups and their religion has been largely influenced by Hinduism This contribution to the ethnology of southern India gives a useful account of an interesting and little-known people

PARTS i and ii of the fifth volume of *Biometrika* were issued together as a double number at the beginning of this month The volume opens with a full and interesting memoir of the late Prof Weldon joint founder and co-editor of the journal who died last spring at the early age of forty-six, many of our readers may be glad to note that this memoir is also obtainable separately from the Cambridge University Press The following article is by Prof Raymond Pearl, on the variation of *Chilomonas paramoecium* under favourable and unfavourable conditions, it is shown that the individuals under unfavourable conditions are smaller than the others and of somewhat different shape, and the relation of these facts to the theories of Driesch and others is discussed The promised issue of the memoir by the same writer, on which some controversy recently took place in our correspondence columns, has, however, apparently been deferred to the next part Dr F A Woods and Mr David Heron, in two independent articles, conclude that neither in man nor in the horse is there any significant inheritance of the sex-ratio, nor is there any evidence of Mendelian inheritance—important contributions to the literature of this subject Dr Macdonell contributes a second study of the English skull, based on crania discovered during excavations in Liverpool Street, and Prof Pearson discusses the relations between intelligence and various physical and mental characters all such relations appearing to be very light The concluding article gives an account of an important investigation, by Dr J W Jenkinson, on the relation between the first furrow, the sagittal plane, and the plane of symmetry in more than 800 frogs' eggs, the results of this investigation show that the conclusions of some previous writers, based on the examination of very inadequate numbers of eggs, have been stated much too confidently the variation exhibited being very large indeed The miscellanea as usual contain a number of shorter articles, chiefly on minor points of statistical theory We note that Dr Macdonell, Mr Elderton, and Prof Pearl are now associated with Prof Pearson in the editing of the journal, and it may be hoped that this assistance will lead to a more regular issue than in the past

IN the second number of the Botanical Journal of the Imperial Society of Naturalists in St Petersburg, Mr and Mrs B Fedtschenko present an article collating the species of Campanulaceæ from Russian Turkestan In the course of an article on the flora of a district in the Government of Riazan mention is made of the discovery of pollen and seed from pine trees in the peat that would indicate the previous extension of coniferous forests many miles further south A description of plants newly recorded from the Crimea is contributed by Mr. A Younghé

ON the subject of cotton cultivation in the Bombay Presidency Mr F Fletcher contributes an instructive article to the *Agricultural Journal of India* vol i part iv Premising that the better the quality the longer the cotton takes to mature five regions are distinguished according to the nature of the soil and the amount of rainfall Of these, the Surtee-Broach and Karnatak tracts are said to be capable of producing the best indigenous cottons while on a portion of the Sind tract that is irrigated excellent Egyptian cotton has recently been grown In the matter of new cottons a promising hybrid is announced from the Surat farm, and cautious but sanguine views are expressed with regard to tree cottons of which two are discussed as forms of *Gossypium peruvianum* and *G barbadense*

AN interesting account giving practical details of the construction of a tramway in connection with the extraction of timber from the forests of Goalpara in northern India, is furnished by Mr W F Perrée to the September and October numbers of the *Indian Forester* For working the forests in question situated north of the Brahmaputra towards the Bhutan border neither sufficient labour nor animals could be maintained, further no water was available in parts of the district, for these and other reasons an experimental tramway was laid down, and subsequently extended for a distance of nine miles from the Brahmaputra Short logs sleepers and water tanks are conveyed on single trucks while large logs are placed on movable frames mounted on the trucks as bogies The details of construction and cost provide useful items for reference

DR E HOWARD ADYE whose careful "Twentieth Century Atlas of Microscopical Petrography" has already been noticed in these pages, is now issuing in parts a work entitled "Studies in Micropetrography," accompanied by actual rock-sections as well as coloured illustrations A prospectus and sample plate can be obtained from the publisher Mr R Sutton, 43 The Exchange, Southwark S E The rock-sections are of the same beautiful character as those issued with the previous atlas, and the subscription price of 4*l* 4*s* for forty-eight of these and twelve parts of the work cannot be regarded as excessive The plates and detailed descriptions should enable the student to go a very long way in self-instruction while the series of preparations would be welcome in any laboratory With a view to systematic arrangement later, we could have wished that the descriptions had been printed on separate and unpaged sheets The interesting volcanic ash of Mont Pelée is included in the first part issued Surely however it would be possible for Dr Adye to quote published litera

ture concerning this material He states that he has found none at present

THE physical papers read at the seventy-eighth meeting of the German Association of Naturalists and Physicians are published in No 20 of the *Verhandlungen* of the German Physical Society, and also in Nos 21 and 22 of the *Physikalische Zeitschrift* A striking case of "chemiluminescence" is described by Prof E Wedekind, the interaction of chloropicrin with magnesium phenyl bromide in ethereal solution is accompanied by the production of a green flame beneath the ether, without the latter, however, being caused to kindle or explode In a dark room the luminescence appears very intense An interesting lecture on the so-called "liquid crystals" was delivered by Prof Lehmann at a general meeting of the association, its general scope was to illustrate how the development of such "crystals" appears to mimic the phenomena usually supposed to be characteristic of the simplest forms of living matter

A COPY of a paper entitled "Niederschlag, Abfluss und Verdunstung auf dem Landflächen der Erde," prepared by Dr Richard Fritzsche to attain his doctorate (Friedrichs Universitat Halle-Wittenberg), has been received The paper is an attempt to re calculate from recent data the total yearly rainfall over the earth's surface, and to indicate the transference of water between land and sea The flow of water through the world's rivers is of course, also considered in detail, and in this connection a very full list of authorities and references is given, adding greatly to the value of the thesis In most cases the figure used is compared with that given by Murray The unit adopted is the cubic kilometre per year The total rainfall over the whole world is given by Fritzsche as 465,300 cubic kilometres per year, which is equivalent to a uniform depth of 91 centimetres Brückner gave 94 centimetres. The rain falling on land is estimated by Fritzsche as 111,940 cubic kilometres per year, by Brückner at 122,540 cubic kilometres and by Murray at 122,318 cubic kilometres per year The amount given by Fritzsche is equivalent to a depth of 75 centimetres Considering only the land which is drained by rivers into the sea, it is calculated that only 30 per cent of the water returns to the sea in this way, the remaining 70 per cent being removed by evaporation The tables which accompany the paper are very full and interesting

SINCE the publication of the first edition of his "Sinnesorgane im Pflanzenreich zur Perzeption mechanischer Reize" (Leipzig Engelmann) in 1901, Prof G Haberlandt has continued his investigations of the sense organs, or organs of perception of plants, and he includes his new observations in the second edition of his work just published The original volume was reviewed in NATURE of April 10, 1902 (vol lxv p 529)

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN JANUARY, 1907 —

Jan 2 7h Neptune in opposition to the Sun
3-4 Epoch of January Meteors (Boötids, radiant 230° + 53°)
4 6h Venus at maximum brilliancy
7 9h 56m to 12h 56m Transit of Jupiter's Sat III (Ganymede)
9 17h 44m to 18h 20m Moon occults γ Libræ (mag 4 1)
10 17h 12m Moon in conjunction with Venus Venus 0° 17′ N
13 Total eclipse of Sun, invisible at Greenwich
14 13h. 13m to 16h 13m Transit of Jupiter's Sat III (Ganymede)
Jan 16 Venus. Illuminated portion of disc = 0 353.
17 11h 28m Minimum of Algol (β Persei).
20. 8h, 17m. Minimum of Algol (β Persei).
21 9h. 7m to 10h 12m. Moon occults ζ² Ceti (mag 4 3).
24 Neptune 1° N, of 36 Geminorum (mag 5 2).
26. 2h 4m Jupiter in conjunction with Moon. Jupiter 2° 37 N.
" 6h 40m, to 7h 45m. Moon occults ν Geminorum (mag 4 1)
28-29 Partial eclipse of Moon invisible at Greenwich

COMETS 1906h (METCALF) AND 1906d (FINLAY) —From observations made at Mount Hamilton and Rome, Herr M Ebell has calculated a set of elliptic elements for comet 1906h, after finding that the observed places could not be satisfied by a parabola The time of perihelion passage, according to these elements, was October 10.714 (Berlin) and the period of the comet is 7 588 years. The elements exhibit a similarity to those of comets Faye, Wolf, 1892 V, 1896 V, and 1900 III, but it is improbable that comet 1906h is identical with any of these, although it probably belongs to the same family An ephemeris extending to January 28 is also given by Herr Ebell, but, as the comet is so extremely faint, it is not worth while to reproduce it here.

On December 8 Prof Hartwig, at the Bamberg Observatory, examined the neighbourhood of the comet, and of the star B D −3° 696, with a 10-inch refractor for the nebulous objects seen at Bordeaux on November 22, but was unable to find them (*Astronomische Nachrichten*, No 4141)

An ephemeris extending to March 22 is given for comet 1906d in No 4140 of the *Astronomische Nachrichten* by M L Schulhof This object is now very faint, and is about 1½° south of Pollux

TWO STARS WITH A COMMON PROPER MOTION —In vol lx of the Monthly Notices of the Royal Astronomical Society Mr Bellamy announced that the two stars AG Berlin B 5072–5073 have a common proper motion and this was confirmed later by Prof Kreutz Additional confirmation now comes from Prof Millosevich, who has compared the available observations since the year 1881 with more recent ones, the last of which was made at Rome at the epoch 1906 39 and finds the proper motion on a great circle to be 1″ 385 in the direction 142° 7′ (*Astronomische Nachrichten* No 4132)

OBSERVATIONS OF VENUS —Continuing his articles on "Planets and Planetary Observation" in the *Observatory*, Mr Denning discusses the observation of Venus in No 377, and points out that the difficulties attending such observations have hitherto prevented any final determination of the planet's rotation period, or of the nature of her surface markings

He also states that the best times to observe the planet are during the evening apparitions in the early part of the year and the morning apparitions which occur in the latter half of each year when Venus is above the horizon for a long time after sunset or before sunrise The chief observations of reputed surface markings which have been made since the time of Galileo are discussed at some length in Mr. Denning's notes

A BRILLIANT METEOR —Mr H E Wood, of the Government Observatory, Johannesburg, records, in No 4141 of the *Astronomische Nachrichten*, the observation of a brilliant meteor on July 16 in various parts of South Africa. An observer at Mbabane in Swaziland, describes the object as a large white ball with a long trail of sparks, and states that it split into two masses each larger than the full moon, whilst a loud explosion accompanied its disappearance Attempts to locate the object, which apparently struck the earth near to Mbabane, have been unsuccessful Mr Wood himself saw a meteor, which he believes to have been the same object, at Johannesburg, two hundred miles away at 8h 45m. p m (standard time of 30° E), but he heard no detonation, although the object was very brilliant and left a trail of sparks As a similar body was observed in Germany on the same evening, Mr Wood suggests that possibly the earth encountered a stream of meteoric bodies on July 16, and that both the observed meteors were members of the same stream

RUBBER CULTIVATION IN THE EAST, AND THE CEYLON RUBBER EXHIBITION

AN exhibition of "rubber" has lately been held in the Royal Botanic Gardens at Peradeniya, in Ceylon, with the most unqualified success, and the time is opportune to see where we stand, and to sum up the work of the scientific institutions which have been engaged in starting this new, and now very prosperous, industry

Rather more than thirty years ago it began to be evident that there was a possibility that, as in the previous case of cinchona, the natural wild rubber supplies—which were then almost solely South American—would in time be exhausted, and an expedition was sent by the Indian Government, aided by the Royal Botanic Gardens at Kew, to the valley of the Amazon, where seeds and plants of the Para rubber—*Hevea brasiliensis*—and other rubber-yielding plants were obtained and safely conveyed to Kew From Kew they were sent to the East, and as it was fairly evident that at that time there was no place in India suitable for their growth, they were sent to the care of Dr Thwaites, in Ceylon, the then director of the botanic gardens in that colony A few were also sent to Singapore and elsewhere These plants arrived in Ceylon in 1876, and were planted chiefly in the low-lying garden of Henaratgoda, which was specially opened for their reception

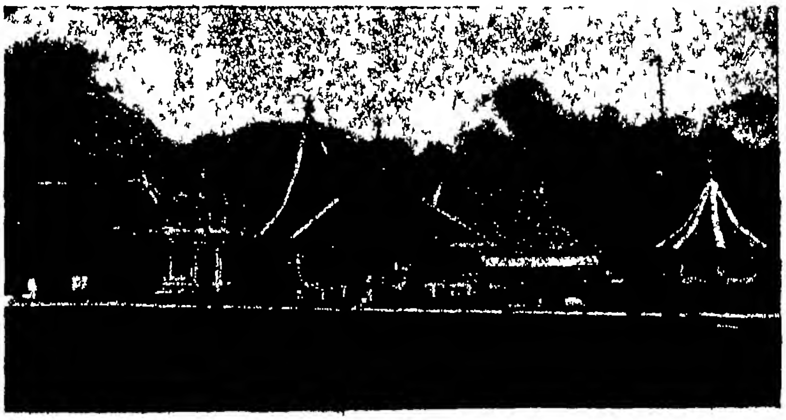
The trees began to seed about 1882 and from that time onwards practically all the seed has been used Of the earlier crops a large part was sent to other countries, but in later years most of the seed was used in the island In 1888 the late Dr Trimen, Thwaites's successor, began to tap one of the original trees at Henaratgoda, and in that year, working in the rough way then practised 1 lb 12 oz of dry rubber were obtained from it V-shaped cuts were made with a chisel, and the milky latex allowed to run down into cocoanut shells and to dry naturally The tree was given a rest in 1889, and in 1890 gave 2 lb 10 oz It was again tapped in every second year following and by 1896, in which year the experiment came to an end, it had yielded 13 lb 7 oz in the five tappings, and was twenty-two years old The average yield was thus about 1½ lb a year, but the tree was twelve years old when the experiments began and was also, instead of being of the average size, the largest tree in the plantation At this rate, therefore, there was but little prospect for success, especially with the price at the comparatively low figure which it then occupied

The next stage in the work was in 1897 when the writer found that the average yield of a plantation of trees about twelve years old might be about 120 lb an acre, and also made the very important discovery of the "wound response" It is found that the second tapping of a given area, provided it is made within about ten days, will yield a larger flow of latex than the first Thus, in the experiments just mentioned, the average yield per tree in the first week was 0 73 oz, in the second week 1 48 oz in the third 0 97 oz, fourth 0 80 oz, and only in the fifth did it fall below that obtained in the first week, being only 0 67 oz This is a discovery of very great importance and one of which a scientific explanation is very desirable From these figures it was calculated that a rubber plantation might show a profit of 27 per cent at the tenth year, and with this the taking up of the industry began in Ceylon, being handicapped only by the very limited supply of seed

In the following year Mr John Parkin came out to Peradeniya as assistant, and was at once started to work at rubber He worked out the whole question of the wound response, and, further, worked out in detail a new method of preparing rubber in far purer condition than had previously been the case Biffen had shown that the essential elements in the smoke used in South America were acetic acid and creosote, and Parkin applied this to the preparation of rubber in the East by collecting the latex in tins containing a little water (to prevent immediate coagulation) and mixing it with the calculated quantity of acetic acid and a little alcoholic solution of creosote The milk being filtered before treatment, the result was to clot it into a perfectly clean "biscuit," which, when rolled out and dried gave more than 93 per cent of caoutchouc, a much higher proportion than had ever before been found in any sample of crude rubber These biscuits were analysed by Messrs Michelin and Co, of Clermont-Ferrand, and after going through the washing machine emerged 99 per cent to 100 per cent against about 80 per cent for any of the best wild rubbers

This work caused a still further demand for rubber seed, but it was still only in limited supply, though the older trees upon private estates were now beginning to come into bearing, and by 1902 there was almost unlimited seed available. At the same time a demand was also springing up in the Malay Peninsula, stimulated by the action of the director of the botanic gardens at Singapore (Mr H N Ridley), who has steadily pushed rubber for many years

For the next three or four years planting went on slowly, and then about the latter half of 1902 began to be rapid, with the increasing supply of seed By the middle of the present year, 1906 there were in Ceylon alone more than 104,000 acres of land planted in rubber, almost solely the Para variety Of the other South American rubbers, the Ceara sort *Manihot Glaziovii*, was largely planted in Ceylon in the early 'eighties, but never quite realised expectations, and has never been more than a minor crop, though the export has never actually ceased The other, *Castilloa elastica*, is a very puzzling tree as yet It grows with great rapidity at first, and then slows down, and though it yields very freely at first tapping, it has no wound response and dies if too severely handled It has only, consequently, been planted on a very small scale as yet Para rubber on the other hand, seems to grow freely up to a small elevation in any part of "wet" Ceylon, and can be very roughly handled without, so far as can be seen, suffering any serious injury None of the other rubber yielding trees has given remunerative returns



Buildings of the Rubber Exhibition held at Peradeniya, Ceylon, on September 13-27

Not only are there already so many acres in Ceylon, but the Malay Peninsula has about 50,000 or 60 000 acres, and many other eastern countries have also considerable areas, all practically under Para rubber only, while in the west Mexico has, it is said, about 20 millions of trees of Castilloa planted, or, allowing 200 trees to the acre an area of about 100,000 acres This we believe to be an overestimate, but at any rate there is a very large area in that country Altogether it is probable that at the present time there are about 275,000 or more acres planted to rubber Allowing that the Para rubber yields twice as much as the Castilloa, this will represent about

230,000 acres, upon which, taking the present Ceylon figures, the eventual yield will be about 400,000 cwt., or 20,000 tons, about a quarter of the probable world's consumption at that date, and planting is going on at a very rapid rate.

The market for a short time looked askance at the biscuits, but they speedily came into favour, and have for a considerable time been receiving a higher price per lb. than the best wild rubber of the Amazon. But this must by no means be taken to mean, as it often is taken, that the plantation rubber is better than the "wild," for the latter contains about 20 per cent. of moisture, while the former is dry, so that in reality the wild rubber is getting about 16 per cent. more in price. Examination of the two qualities will at once show the reason for this difference; the plantation rubber is not quite so elastic, and when much stretched does not at once return, as does the wild rubber, to its exact pristine shape. What the reason for this difference may be is the great problem now before the scientific institutions working at the chemistry and botany of rubber in the tropics.

During the last four years the prices of rubber have continued to rise until they have now reached a height previously undreamt of. The result has been that the early pioneers of rubber cultivation have reaped enormous profits, amounting to as much, in some cases, as 60*l*. per acre per annum, and this has still further stimulated the rush into rubber planting.

The one topic of conversation in planting circles in the East is now rubber, and almost everyone, whether a planter or not, has invested in the industry, with the result that shares have risen very considerably, being in the case of companies owning bearing rubber now from three to eight times their par value. With this degree of interest excited in it it is hardly surprising that a proposal was made that Ceylon, the country in which most rubber was cultivated, should hold a rubber exhibition, and this was actually held in the famous Royal Botanic Gardens at Peradeniya from September 13 to 27.

Buildings upon a fairly extensive scale were erected in Kandyan or mountain Sinhalese style, and a large display of every kind of rubber was obtained, mainly, of course, from Ceylon and Malaya. There were also exhibits of tapping knives of every kind, and two large sheds were filled with the machinery that is rapidly coming into use upon rubber plantations. A very successful feature of the exhibition was the series of lectures upon every branch of rubber cultivation, shipment, and manufacture that was given during its progress, and which will shortly appear in a book which should be at the hand of everyone interested in rubber.

The bulk of the Ceylon exhibits were in the form of biscuits, the form originally adopted by Mr. Parkin in the laboratory having been long adhered to. The Malayan were in the form of sheets of larger size, but the most conspicuous things in the show, from this point of view, were some large blocks of rubber exhibited by the Linadron Estate in Jahore, made by pressing what is known as crepe rubber (obtained by aid of a washing machine) into solid blocks by powerful hydraulic pressure. Not only does this form offer less surface to oxidation, but it packs more closely, and thus saves freight, and it also sells for more upon the market.

The tapping knives for Para rubber exhibited much ingenuity, but not those for the other rubbers. It is worth pointing out here that persons interested—and who is not?—in introducing rubber cultivation into other countries should keep a sharp eye upon the development of the tapping knife in Ceylon and Malaya. Recent experiments in the West Indies, for instance, were carried out with a knife long since discarded in Ceylon, and the verdict was against this knife and in favour of the hammer and chisel, which form a very primitive tool indeed.

Some of the most interesting exhibits in the whole show were the samples of vulcanised and coloured rubbers, rubber and fibre mixtures, and other things shown by Mr. M. Kelway Bamber, Government chemist in Ceylon. These were referred to by Prof. Dunstan at the meeting of the British Association at York, and have aroused universal interest. Several technical papers have already given vent to the view that they can never be put to practical use, because each manufacturer has his own processes, which he will keep secret, for mixing and otherwise treating the rubber, apparently assuming that it is hopeless for the mere scientific man to find out such matters, or even to improve on them, or for one company, old or new, to take up the new process. Others, going on insufficient knowledge, have said that it is not possible to work with chloride of sulphur, or to mix other substances with the latex. In actual fact, the process is very simple, so simple that it seems a marvel that no one has found it out before. Instead of first drying the rubber into lumps or sheets, then macerating it, and mixing it with sulphur or other vulcanising material and colouring matters, these things are done *in the milk*, when the sulphur compounds will, of course, mix with the caoutchouc in a way that it is hopeless for any other method to equal, and when anything that can be wetted can also be easily incorporated, more especially colouring matters. In this way, by subsequent coagulation, a rubber is produced containing the vulcanising, colouring, and mixing reagents or substances in complete admixture. This can then be worked up in the ordinary way into any article that may be required, and finally heated, when it becomes vulcanised. Some of the most interesting exhibits shown by Mr. Bamber were the mixtures of rubber and fibre. The fibre is mixed with the milk in large quantity, the milk being previously sulphurised, and the mass is then dried, compressed under very great hydraulic pressure, and heated, resulting in a solid brick or tile containing but a very small proportion of rubber, and yet strong and elastic enough for the purposes of tiling or other uses.

This method of vulcanising will doubtless have to be modified in detail, but in principle is absolutely new, and is much simpler, and also much cheaper, than the present one.

Taking it altogether, the creation of the now great rubber industry, and its rapid progress from very rough and crude methods to a highly progressive and scientific spirit, is entirely the work of the botanical departments of Ceylon and Singapore, and they may justly pride themselves upon the result.

Recent Important Literature of Rubber.

"Para Rubber." By W. H. Johnson. (London.) Price 7*s*. 6*d*. A very good account of the industry as it was in Ceylon a few years ago, but already more or less out of date.

"Para Rubber." By Herbert Wright. Second edition. (Colombo: A. M. and J. Ferguson.) The best and most up-to-date account of the industry.

"The Book of the Rubber Exhibition of 1906." By J. C. Willis, M. K. Bamber, and E. B. Denham. (London: Dulau and Co.) Price 7*s*. 6*d*. To appear shortly. This book will contain the lectures given at the exhibition by numerous specialists, carefully revised and edited, many pictures, reports of judges, and other valuable features.

J. C. WILLIS.

METEOROLOGICAL NOTES.

"COLD Waves and Frosts in the United States" is the title of an important bulletin recently issued by the chief of the U.S. Weather Bureau. The work was prepared by Prof. E. B. Garriott; it includes a chronological account of historical cold periods in the United States since 1717, but deals more especially with the frosts that occurred from 1888 to 1902 inclusive, the conditions of which are illustrated by 328 charts. We have occasionally very cold spells in our own country, but these can scarcely be compared with those frequently experienced in the United States; as Prof. Moore has elsewhere pointed out, the area and intensity of cold waves depend upon the size of continents and their distance from the tropics. The author of the paper considers that the cold of the northern interior of the American continent is chiefly due to air that flows over that region from the northern Rocky Mountains, where its moisture has been precipitated, and to the process of radiation in its passage over Canada. The high barometer caused by the stagnant state of the air in this locality is one of the conditions that produce cold waves; another

necessary condition being the development of low barometric pressure near the southern margin of the cold-air belt, and the production of strong northerly currents due to cyclonic circulation. To quote only one instance of the value of forecasts in connection with these cold waves:—from January 6–12, 1886, a cold wave swept the country east of the Rocky Mountains and produced the lowest temperatures noted for the last fifty years in the south-eastern States. Speaking of this wave, Prof. Moore has stated that on January 7 there was a difference of 1·1 inch in barometric pressure between Montana and southern Texas, while the isotherm in Montana was −30° and on the Texas coast 50°. The people of the Gulf States knew nothing of the danger that threatened them until warned by the telegraphic weather forecast; on January 8 the temperature in parts of Texas had fallen to zero, and, notwithstanding the timely notice, the estimated damage to crops was 3,000,000 dollars in Florida alone.

Diurnal Range of Temperature in the Tropics.—Prof. J. Hann recently presented an important treatise on this subject to the Vienna Academy of Sciences. In continuation of a former work dealing with the district between lat. 15° N. and S., the one now in question relates to places in Africa and America (including the West Indies, Madagascar, and Mauritius) lying north and south of the above latitudes, and extending to the limits of the tropics and in some cases beyond them. The work is divided into two parts, containing, *inter alia*, (1) tables of the daily range of temperature in the form of departures of the hourly from the daily means, with a general discussion of the results, and (2) tables of the periodical and non-periodical amplitudes, and of the epochs of the daily maxima and minima, in connection with cloudiness, sunshine and rainfall. The mean occurrence of the minimum temperature at all places in the tropics (mountain stations excepted) is approximately at 5h. 30m. a.m., both on the coast and inland. The time of the maximum differs; on the coast and in rainy districts it mostly occurs soon after midday, at inland and dry stations it is at 2h. or even after 2h. 30m. p.m. At places on the West Indian coasts the maximum occurs about 42m. after noon, somewhat more inland, at Puerto Principe (Cuba) nearly an hour later, and at the City of Mexico about 2h. 48m. p.m. The occurrence of the daily mean is retarded according to distance from the equator; twenty-seven stations in the central zone (lat. 15° N. to 15° S.) give the mean time of 8h. 26m., twenty stations in the outer zones give 8h. 40m., as compared with 9h. 27m. at fifteen places in Austria.

Diurnal Variation of the Barometer.—In the *U.S. Monthly Weather Review* for April, Prof. Cleveland Abbe directs attention to an article in *Gaea* for August, 1905, by Dr. Korselt, of Annaberg, Germany, in which he attempts to show how the diurnal oscillation of the barometer is an important link in the chain of phenomena due to the unequal warming of the atmosphere by solar radiation and its unequal cooling by terrestrial radiation. One of his conclusions which may be recommended to the notice of meteorological organisations the telegraphic reporting stations of which generally possess self-recording barometers is that the minute study of the daily barometric oscillation may be of great value for practical weather forecasting, because it ought to give information about conditions in the atmosphere at altitudes which balloons have not yet been able to attain. A weather chart showing the observed difference between the barometric ranges by day and by night during the preceding twenty-four hours would, he thinks, probably show that any temporary area of low pressure has a tendency to move toward the region where the difference of the ranges is a minimum. Prof. Abbe points out, however, that these ranges are so small that they would often be completely masked by larger non-periodic changes, so that misleading errors would seem to be inevitable.

Influence of the Ocean upon Continental Precipitation.—In the same number Mr. F. O. Stetson (assistant editor) directs attention to a recent paper read before the Société helvétique des Sciences naturelles on the interchange of moisture between land and sea by Prof. E. Brückner. The author estimates that 93 per cent. of the water evaporated from the ocean is returned to it in the form of precipitation, leaving only 7 per cent. available for distribution over the land, and that of the total precipitation over the land 20 per cent. is supplied directly by the ocean, while the remainder is due to the re-condensation of vapour evaporated from the continents. We cannot give here the data upon which Prof. Brückner's figures are based, but if they are provisionally accepted as approximately correct, they indicate that the direct influence of the ocean upon rainfall over the land is less than has been generally supposed; but Mr. Stetson points out that the accurate determination of evaporation is a problem not yet solved, and that the rainfall over extensive tracts of land still remains unknown.

Wind Currents in the Vicinity of the Canary Islands.—In a recent note to the *Comptes rendus* of the Paris Academy, M. Teisserenc de Bort and Mr. Rotch have confirmed their opinion that the south-west winds observed on the Peak of Teneriffe correspond to a general phenomenon and are identical with those which would obtain over the open ocean, and consequently represent the regular anti-trade. This view is not in accordance with that held by Prof. Hergesell, to which he has again directed attention in *Beiträge zur Physik der freien Atmosphäre* (vol. ii., part ii.). He maintains that his observations with kites in 1904, and the balloon observations of the *Princess Alice* in 1905, show that in the latitude of the Canary Islands during summer north-west winds prevail to the greatest heights, and that there can be no question of a regular south-west current in that part of the Atlantic, the occasional south-west wind observed on the Peak of Teneriffe being due to local effects. Prof. Hergesell in no wise denies the existence of the regular south-west anti-trade wind, but maintains that at all seasons it is only to be met with some degrees south of the Canaries.

The Hong Kong Typhoon, September 18.—The Zi-ka-wei Observatory (near Shanghai) has sent us some interesting details relating to the progress of this most disastrous storm, which reached Hong Kong on September 18. The first signals of its approach were given by the Japanese observations in the islands east of Formosa on the morning of September 15, but owing to the distance of the stations from the central vortex it was not until the following day that it was clearly shown to be moving towards Formosa and China. The supplement to the Zi-ka-wei Daily Weather Report of September 30 contains some important extracts from ships' logs which clearly show the definitive track of the storm. The U.S. transport *Caesar*, bound from Cavite (Bay of Manila) to Shanghai, was at noon of September 15 in lat. 19° 53′, long. 120° 20′; at 4h. p.m. she had a steady wind from N.W., freshening in force to 7; the usual diurnal barometric range was still observed, but at 8h. p.m. the barometer, which stood at 29·60 inches, began to fall, the wind freshened and veered to N.N.W., and the ship was forced to steer S.W. to avoid the centre of the approaching storm. The observations were:—at 1h. a.m. on September 16, barometer 29·36 inches, wind N.W. 11; at 2h. a.m., 29·37 inches, W.N.W. 11; at 3h. a.m., 29·40 inches, W. 11; during this period the rain was continuous and excessively heavy. The centre of the storm passed between the ship and the south Cape of Formosa on September 16 shortly after 1h. a.m.

The P. and O. SS. *Delhi* was just entering the passes of Hong Kong when the typhoon burst upon the colony. At noon on September 17 she was in lat. 17° 58′, long. 111° 35′, about 420 miles from the vortex, wind S. force 2, and a distinct E.N.E. sea swell was noted. It was not until 4h. a.m. next day that the breeze veered to W. with occasional squalls, barometer 29·78 inches. The ship dropped anchor near Green Island, and the wind freshened, being W. by N., 8, at 9h. 30m. and W. by S., 10, at 10h. a.m., while the rain fell with blinding violence. At 9h. 45m. the barometer reached its lowest point, 29·14 inches. The centre of the storm passed to the north of the *Delhi* between 9h. 45m. and 10h. a.m. As shown by the observations of these two vessels and those of the French mail steamer *Océanien*, which left Hong Kong for Shanghai on the afternoon of September 17, the centre of the storm travelled from Formosa to Hong Kong, about 380 miles, in 56½ hours, at a mean rate of 6·7 miles an hour; the rate of translation was probably checked by the very high atmospheric pressure to the north, but it

became faster as the centre progressed nearer the coast, where it reached 143 miles an hour; the high pressure to the north also made the gradient steeper, and so increased the violence of the vortex. The track of the storm was approximately W.N.W. or W. by N.

The Rev. José Algué, S.J., director of the Manila Observatory, has published an article upon the above typhoon in the Monthly Bulletin of the Philippine Weather Bureau for September. The observations at Santo Domingo (Batanes Islands) and at Aparri (Luzon) show how accurate were the warnings and particulars of the track of the storm issued by the Zi-ka-wei Observatory, and that the typhoon passed close to the north of Santo Domingo between 3h. and 4h. p.m. on September 15, the centre moving in the direction of N.W. by W.; the barometric minimum at the latter place at 2h. 30m. p.m. on that day was 29.290 inches, the mercury having fallen 0.572 inch since 8h. p.m. on September 14. Father Algué thinks it probable that a depression felt at Guam (Marianne Islands), lying to the eastward of Santo Domingo, on September 8, may have been caused by the passage of the typhoon about 200 miles to the north of that station; in this case its mean rate of progression to Santo Domingo would have been about eight nautical miles an hour.

Report of the Fernley Observatory, Southport, for the Year 1905.—This institution, which is maintained by the Corporation, occupies an important position between the Liverpool Observatory and the anemograph station at Fleetwood, and possesses an exceptionally complete equipment of standard self-recording instruments. The year was very dry, the rainfall being 26.31 inches, or 7.11 inches below the average. Owing to the position of the observatory on the coast of the Irish Sea gales were experienced in every month, but although barometric pressure was lowest in November, this was one of the two calmest months, the other being May. The town enjoys a good amount of bright sunshine; in the year a duration of 1624 hours was recorded, or seventy hours above the average, being only about fifty hours less than at Brighton, and above 300 more than in the London district.

Annuaire météorologique, Observatoire Royal de Belgique 1906.—Although, as pointed out by M. Lancaster, an *Annuaire* is not indispensable for a meteorological organisation, the results of its observations being given in other publications, it is a very convenient method of bringing together data useful to different classes of workers, including agriculturists, engineers, medical men, and others. The work in question is certainly most valuable, and contains, in concise and handy form, the yearly and average results of observations made at Brussels (or Uccle) since 1833, together with a summary of miscellaneous information, including tables and constants which are both useful and instructive to meteorological students of any country. To render the publication more attractive, it contains from time to time original articles by members of the observatory staff. Amongst those contained in the current volume we may mention one by M. Vincent on weather prediction, illustrated by fourteen maps, as well worthy of attention. The author looks for future improvement in the wider dissemination of daily weather reports and the instruction of persons interested in drawing their own conclusions from the synoptic charts, in decentralisation to some extent, in the preparation of local forecasts as in the United States, and, eventually, in each person becoming his own forecaster, from information supplied by the central offices.

Climate of Alaska.—In the *U.S. Monthly Weather Review* for June reference is made to an important memoir on this subject by Dr. C. Abbe, jun., which forms part of Professional Paper No. 45 of the U.S. Geological Survey. Dr. Abbe summarises the materials collected during the last thirty years by the Signal Service and the Weather Bureau, and therefore supplements the useful memoir by Dr. Dall published in the Pacific Coast Pilot in 1879. The territory is divided into eight climatic provinces, for each of which much fresh information is afforded, especially as regards temperature and rainfall. The maximum shade temperature in the great Yukon basin is given as 90°, and 94° on the Copper River plateau, is the highest reported from any of the Weather Bureau stations, instead of 112° or even 120° formerly spoken of. The lowest recorded temperature is −80°, at Fort Reliance, in January. The largest annual rainfall is 170.09 inches, at Fort Constantine; the number of rain days is 251, at Unalaska, being the highest number at any point in the United States.

Meteorological Observations, Bremen, 1905.—The publication of the results obtained at this important observatory under the superintendence of Dr. P. Bergholz forms part of the German *Meteorologisches Jahrbuch*, which is prepared on a uniform plan for all parts of the empire. The present volume is of more than usual interest, as, in addition to hourly readings and means from self-recording instruments for the year in question, it contains monthly, seasonal, and yearly means for the lustrum 1901–5, results for the thirty-year period 1876–1905, and for all observations available from 1803–1905. As the latter are not quite continuous, we quote the following data for the thirty-year period:—mean temperature, January, 32°.5, July, 62°.6; the absolute extremes were 93°.9 (May 28, 1892), −13° (December 4, 1879); means of the absolute monthly extremes, 11°.1, January, 83°.5, July. The mean annual rainfall was 27.48 inches, July, 3.64 inches, April, 1.63 inches; the greatest fall in one day was 3.39 inches (June 10, 1884). The mean percentage of bright sunshine for fifteen years was 32.4, as compared with 29 per cent. in London for twenty years.

BRITISH INLAND WATERWAYS.

THE commissioners appointed early this year to investigate and report on this important question, have exercised a wise discretion in publishing, as soon as practicable, the first portion of the evidence given before them by fifty-four witnesses, at twenty-two meetings, held between March 21 and July 31, relating almost entirely to English canals and inland navigations. This first instalment forms a fairly bulky Blue-book, with 375 pages of evidence, an index of ninety-five pages, various appendices, together with a list of English inland waterways, occupying 111 pages, and a map of the canal-systems and navigable rivers of England and Wales in two sheets at the end of the volume, coloured so as to indicate each separate system, with the name of the system printed in large letters of the same colour.

Since the evidence here recorded was taken, the commissioners have been hearing evidence in Ireland on Irish inland waterways, and have also resumed lately their sittings in London; and they further propose to obtain detailed information with regard to inland navigation in the Continental countries of Europe where it has been most fully developed, which will doubtless be published in due course. Accordingly, considering the large amount of matter with respect to inland waterways which will be gradually collected by this commission, it is very advantageous that it should be given to the public at intervals to give an opportunity of its being properly studied; and this arrangement has the further merit that it will enable future witnesses, by seeing the previous evidence beforehand, to supply omissions or correct errors.

A perusal of the engineering evidence alone suffices to show by its conflicting nature, the magnitude of the task which lies before the commissioners, and the complicated problems which they will have to solve. The questions to be considered with regard to the improvement of inland waterways are:—first, the additional traffic that an improved waterway would be likely to attract; secondly, the size of barges which could most economically transport the traffic; thirdly, what would be the cost of a transformed waterway suitable for the passage of such barges, how far it should be carried inland, what connections should be formed with other waterways, and what return might be expected on the capital expended; and, lastly, by what means the funds might be raised for executing the proposed improvements.

The engineers of inland navigations being sometimes also the managers, or generally concerned in the management of their system, and being thoroughly conversant with the cost of improvements and with the working expenses, have for the most part dealt with the above questions in their evidence. One engineer suggests that the Government

should undertake the improvement of the tidal portions of the rivers; that above this limit the local authorities should improve the rivers by canalisation up to a town conveniently situated to form an inland port, up to which sea-going vessels of 400 or 500 tons could come, and which would serve as a distributing or receiving centre for waterways of suitable dimensions penetrating into the interior, and that in some cases, for surmounting high summit-levels, inclined planes worked by locomotives should be substituted for canals. Another engineer proposes that the Government should undertake through routes for vessels of 350 tons from Birmingham to Liverpool Hull, the Severn, and London, and between Liverpool and Hull, and from London to Bristol, and considers that these main routes would be certain to yield a profit on the purchase of the existing waterways involved in the schemes and on the expenses of construction, which could then be utilised in acquiring and improving other waterways A third engineer desires to make each river-basin a separate system; he considers that a barge of 150 tons is the largest barge that would pay, and instead of bringing sea-going vessels inland, he would bring these inland barges down to the tideway, where transhipment into sea-going craft would take place most conveniently A fourth engineer considers that 100-ton barges are the largest size expedient for English inland navigation, and that in certain cases the improvement of canals to accommodate them would not pay, whilst a fifth engineer thinks that any improvements of inland waterways would prove an unprofitable and useless expenditure

It is evident from this summary of the views expressed by some of the most experienced engineers with reference to inland navigation, that the commissioners, after having collected all the evidence available, will require some time to formulate their recommendations, and to decide how far Continental practice with regard to inland waterways is applicable to the special conditions of the United Kingdom

THE SCIENTIFIC STUDY OF INFECTIOUS DISEASES [1]

THE wider recognition of medical science as a rewarding object of endowment is a result of discoveries made during the last quarter of a century, and it is of interest to inquire why this increased knowledge should have borne such abundant fruit The result is not due to any change in the ultimate aims of medicine, which have always been what they are to-day and will remain—the prevention and the cure of disease—nor to the application to the solution of medical problems of any higher intellectual ability and skill than were possessed by physicians of past generations, nor to the growth of the scientific spirit, nor to the mere fact of a great scientific advance in medicine, for the most important contribution ever made to our understanding of the processes of disease was the discovery by Virchow in the middle of the last century of the principles and facts of cellular pathology, the foundation of modern pathology

The awakening of this wider public interest in scientific medicine is attributable mainly to the opening of new paths of investigation which have led to a deeper and more helpful insight into the nature and the modes of prevention of a group of diseases—the infectious diseases—which stand in a more definite and intimate relation to the social, moral, and physical well-being of mankind than any other class of diseases The problems of infection which have been solved and kindred ones which give promise of solution are among the most important relating to human society. The dangers arising from the spread of contagious and other infectious diseases threaten, not the individual only, but industrial life and the whole fabric of modern society. Not medicine only, but all the forces of society are needed to combat these dangers, and the agencies which furnish the knowledge and the weapons for this warfare are among the most powerful for the improvement of human society

[1] Abridged from an address delivered by Dr. W. H. Welch at the formal opening of the Laboratories of the Rockefeller Institute for Medical Research on May 11

Great as was the material, intellectual and social progress of the world during the past century, there is no advance which compares in its influence upon the happiness of mankind with the increased power to lessen physical suffering from disease and accident, and to control the spread of pestilential diseases

Before some accurate knowledge of the causation of infectious diseases was secured preventive medicine was a blundering science, not, however, without its one great victory of vaccination against small-pox, whereby one of the greatest scourges of mankind can be controlled and could be eradicated, if the measure were universally and efficiently applied The establishment upon a firm foundation of the germ doctrine of infectious diseases, the discovery of the parasitic organisms of many of these diseases, the determination by experiment of the mode of spread of certain others, and the experimental studies of infection and immunity have transformed the face of modern medicine

The recognition, the forecasting, the comprehension of the symptoms and lesions, the treatment of a large number of infectious diseases have all been illuminated and furthered, but the boon of supreme import to the human race has been the lesson that these diseases are preventable.

Typhus fever, once widespread, and of all diseases the most dependent upon filth and overcrowding, has fled to obscure, unsanitary corners of the world before the face of modern sanitation

In consequence of the knowledge gained by Robert Koch and his co-workers Asiatic cholera, to the modern world the great representative of a devastating epidemic, will never again pursue its periodical, pandemic journeys around the world, even should it make the start

Of bubonic plague, the most dreaded of all pestilences, which disappeared mysteriously from the civilised world more than two centuries ago, we know the germ and the manner of propagation, and, although it has ravaged India for the last ten years with appalling severity, it can be and has been, arrested in its spread when suitable measures of prevention are promptly applied

Typhoid fever, the most important index of the general sanitary conditions of towns and cities, has been made practically to disappear from a number of cities where it formerly prevailed That this disease is still so prevalent in many rural and urban districts of the United States is due to a disgraceful neglect of well-known measures of sanitation

To Major Walter Reed and his colleagues of the United States Army Commission an inestimable debt of gratitude is due for the discovery of the mode of conveyance of yellow fever by a species of mosquito On the basis of this knowledge the disease, which had been long such a menace to lives and commercial interests in the Southern States, has been eradicated from Cuba, and can be controlled elsewhere

Another army surgeon, Major Ross, acting upon the suggestion of Sir Patrick Manson, had previously demonstrated a similar mode of incubation and transportation of the parasite of malaria, discovered by Laveran, and it is now possible to attack intelligently and in many localities, with good promise of success, the serious problem of checking or even eradicating a disease which renders many parts of the world almost uninhabitable by the Caucasian race and, even where less severe, hinders, as does no other disease, intellectual and industrial activities of the inhabitants

The deepest impress which has been made upon the average death-rate of cities has been in the reduction of infant mortality through a better understanding of its causes The Rockefeller Institute, by the investigations which it has supported of the question of clean milk and of the causes of the summer diarrhœas of infants, has already made important contributions to this subject which have borne good fruit

No outcome of the modern science of bacteriology has made a more profound impression upon the medical profession and the public, or comes into closer relation to medical practice, than Behring's discovery of the treatment of diphtheria by antitoxic serum, whereby in the last twelve

years the mortality from this disease has been reduced to nearly one-fifth the former rate

The most stupendous task to which the medical profession has ever put its hands is the crusade against tuberculosis, the preeminence of which as the leading cause of death in all communities is already threatened. Sufficient knowledge of the causation and mode of spread of this disease has been gained within the last quarter of a century to bring within the possible bounds of realisation the hopes of even the most enthusiastic, but it will require a long time much patience, and a combination of all the forces of society, medical, legislative educational, philanthropic, sociological, to attain this goal

But great and rapid as the progress has been, it is small in comparison with what remains to be done. The new fields which have been opened have been explored only in relatively small part. There still remain important infectious diseases the secrets of which have not been unlocked. Even with some the causative agents of which are known, notably pneumonia and other acute respiratory affections and epidemic meningitis, very little has yet been achieved by way of prevention. The domain of artificial immunity and of the treatment of infections by specific sera and vaccines, so auspiciously opened by Pasteur and by Behring is still full of difficult problems the solution of which may be of immense service in the warfare against disease. Of the cause of cancer and other malignant tumours nothing is known although many workers with considerable resources at their disposal are engaged in its study. With the change in the incidence of disease due at least in large part to the repression of the infections of early life increased importance attaches to the study of the circulatory renal, and nervous diseases of later life of the underlying causes of which we are very imperfectly informed. There are and will arise medical problems enough of supreme importance to inspire workers for generations to come and to make demands upon all available resources

In full recognition of the dependence of success in the warfare with disease upon increase of knowledge the Rockefeller Institute for Medical Research was founded by the enlightened munificence of Mr John D Rockefeller, to whom grateful acknowledgment is made. Likewise to the broad sympathies and active interest of his son, Mr John D Rockefeller, jun the origin and development of this institute are largely indebted

May the hopes of the founder and of those who have planned this institute be abundantly fulfilled! May it contribute largely to the advancement of knowledge and may the streams of knowledge which flow from it be "for the healing of the nations"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

A RECENT report of President Butler, of Columbia University refers to the salaries paid to the professors and adjunct professors of the University. This part of the report was reprinted in Science for November 23. President Butler says that these salaries are inadequate and that the effects of this inadequacy are deplorable. The report shows that the present average salary paid to a Columbia University professor is but one-half of the sum fixed as necessary thirty years ago and that the cost of living has meanwhile increased between 10 per cent and 20 per cent. The purchasing power of the average salary of 1900 is therefore, hardly more than 40 per cent of the purchasing power of the salary established in 1876. In other words the great expansion of the University, which has been brought about by the labours of the university teachers has also been brought about at their expense. In President Butler's judgment the most important need of Columbia University at the present time is an addition to the endowment fund sufficient to enable the establishment and maintenance of a proper standard of compensation to members of the teaching staff. There are 119 professors and thirty-nine adjunct professors, 158 in all. To increase the salary of each by only 200*l* on an average—not at all an adequate amount—would absorb the interest at 5 per cent on a capital sum of more than 600,000*l*. The need is so imperative and the public interests affected by it are so important, the report states, that the mere statement of it ought to bring the needed sum, great though it is, from the American men and women who are the large-minded possessors of wealth

THE scheme for the establishment at Bristol of a university for the west of England is now taking definite shape. The sum of 40,000*l* has already been promised, and with the buildings of University College, which are worth about another 50 000*l*, the scheme may be said to have made a good start. There was a difficulty in arriving at an arrangement between the Merchant Venturers' work in higher education and that of University College, but we understand that the Merchant Venturers have practically accepted the principle of the proposed university and though details remain to be settled, there is good reason to believe that the movement will now go forward with every promise of success. Speaking at the Merchant Venturers' Technical College, Bristol, on December 20 Prof M F Sadler referred to the energy with which the Merchant Venturers had furthered the work of technical instruction, and expressed the hope that it would be found possible to unite the Technical College with the University College, and thus to form the nucleus of a great University of Bristol. Under modern conditions universities should combine opportunities for advanced technological, commercial and professional training with the highest tradition of literary and philosophical culture. There is still room, in spite of other recent foundations, for a new university in England with its seat at Bristol, but the nation will not gain by the establishment of a university weak because ill-endowed and insufficiently equipped with teachers, laboratories, libraries, and the buildings indispensable to the social side of university life. The rapid growth of Bristol in recent years encourages the hope that its citizens will emulate the example of Manchester Liverpool Birmingham Leeds, and Sheffield in the building up of a great modern university

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 8 — "On the Occurrence of Encystation in *Trypanosoma grayi*, Novy, with Remarks on the Method of Infection in Trypanosomes Generally" By Prof L A **Minchin** Communicated by Prof Ray Lankester

In a former communication to NATURE (November 15 p 56) an account was given of the results obtained by the Sleeping Sickness Commission at Entebbe Uganda, with regard to the transmission of the *Trypanosoma gambiense* of sleeping sickness, and other trypanosomes, by *Glossina palpalis*, the dusky tsetse-fly[1]. It was shown (1) that the infection was a "direct mechanical" transmission by the proboscis, and that no "cyclical" infection comparable to that of malaria, could be discovered, (2) that *T gambiense* appeared to die out in the intestine of the fly after ninety-six hours, (3) that besides *T gambiense*, the fly carried two other species of trypanosomes, named *T grayi* and *T tullochii* respectively

Since the article referred to was written, it has been found that *T grayi* becomes encysted in the hind-gut of the fly and all analogies with other Protozoa suggest that the cysts are destined to be cast out and infect fresh hosts probably in this case, the vertebrate hosts from which the fly obtains the trypanosomes. This suggests the occurrence of a hitherto unsuspected mode of infection by trypanosomes, in which the parasites, when taken up from the blood of the vertebrate by the blood sucking invertebrate, pass in the gut of the latter, through a developmental cycle, which ends in the parasites becoming encysted. In this condition they are cast out and re-infect the vertebrate host by contaminating its food or drink. Such a mode of infection is termed "contaminative," as contrasted with the "inoculative" method seen in malaria and hitherto vainly sought for in these trypanosomes

[1] Mr E E Austen, of the Natural History Museum, has suggested to the author that *Glossina palpalis* should be distinguished in this way from the other seven known species of tsetse flies

Moreover, as it may be supposed that what one species of trypanosome does another may do, the encystation seen in *T. grayi* arouses the suspicion that the disappearance of *T. gambiense* from the gut of the fly may be due also to a similar cause.

Society of Chemical Industry, December 3.—Dr. J. Lewkowitsch in the chair.—The direct estimation of antimony: H. W. **Rowell.** The sample of finely powdered ore or fine metallic sawings containing about 0·14 gram of antimony is weighed into a 500 c.c. beaker and dissolved in 25 c.c. of strong hydrochloric acid. 5 c.c. of saturated solution of bromine in hydrochloric acid are run in, and any insoluble matter is fused in caustic soda and returned to the main bulk. Three grams of sodium sulphite are added, and the mixture boiled down to 10 c.c. to drive off sulphurous acid and arsenic. The solution is titrated at a boiling temperature, after the addition of 60 c.c. of hydrochloric acid (1–3), with N/20 potassium bromate until the colour of the methyl orange indicator is destroyed. The bromate is standardised with 0·082 gram of arsenious oxide dissolved in hydrochloric acid, which is equivalent to 0·1 gram of antimony. Copper raises the result slightly, and iron very slightly, but precautions are given for obviating their effect. The method may be applied to materials containing antimony, and examples are given illustrating the accuracy of the method, the effect of copper and variations in samples of alloys.—The detannisation of solutions in the analysis of tanning materials: Dr. J. Gordon **Parker** and H. Garner **Bennett.** The authors deal with the four chief methods used for the analysis of tanning materials and extracts, and compare the official method of the International Association of Leather Trades Chemists, which consists of detannisation by means of a column of prepared hide-powder in a specially made filter bell, with the German method, with the method devised by Kopecky, and, finally, with the official American method. The authors confirm the work that has been done by Reed and other American chemists, and disprove the claims made by Paessler that a dry chromed hide powder used in the filter bell gives the most accurate results. The authors finally recommend that the International Association of Leather Trades Chemists should at once adopt the American method, either as it now officially stands or in a modified form.

Geological Society, December 5.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The geological conditions which have contributed to the success of the artesian boring for water at Lincoln: Prof. E. **Hull.** This boring has its source of supply in strata which rise to the west, but to the east dip down towards the North Sea. The water-yielding stratum is reddish, soft, porous sand-rock, reached at a depth of 1561 feet, and penetrated to a depth of 474 feet. About one million gallons of water rise to the surface daily. The sand-rock belongs to the New Red Sandstone. The hydraulic pressure at the bottom of the boring is that due to about 2035 feet, and the friction of the water in percolating the rock accounts for the fact that the water can be pumped down during the day but rises again in the night. The formations penetrated are:—Alluvium and Lower Lias, 641 feet; Rhætic beds, 52 feet; Red Marl and Lower Keuper Sandstone, 868 feet; Bunter Sandstone, 454 feet. The quantity of water drawn from the New Red Sandstone amounts to not less than twenty million gallons, and the total available quantity of water percolating into the Sandstone amounts to about 300 millions.—Notes on the raised beaches of Taltal (northern Chile): O. H. **Evans.** The town of Taltal is situated partly on the dry bed of a river and partly on an inclined plain that fringes the bays of the coastal ranges to the northward, and runs up the valleys. The material of this plain consists of sands and rounded gravel derived from the rocks of the adjacent hills, mingled with shells and some isolated boulders. The formation is impregnated with salt, and there protrude through it weathered remnants of former stacks and islets. The plain rises in terraces, the highest of which are somewhat obscure, and sometimes portions of these higher terraces are preserved in the stacks and islets. A second coastal shelf also occurs, marked by a line of shallow caverns. Beds of shells in the gravel, containing whale-bones, give evidence of the marine origin of the terraces.

Chemical Society, December 6.—Prof. R. Meldola, F.R.S., in the chair.—Action of reducing agents on 5-chloro-3-keto-1:1-dimethyl-Δ^4-tetrahydrobenzene: A. W. **Crossley** and Miss N. **Renouf.** Sodium in moist ethereal solution gives, as main product, 3-hydroxy-1:1-dimethylhexahydrobenzene, whereas sodium in absolute alcoholic solution yields a small amount of this alcohol, and to a much larger extent 3-hydroxy-5-ethoxy-1:1-dimethylhexahydrobenzene. With zinc filings in aqueous solution either in the cold or on heating, 3-keto-1:1-dimethyl-Δ^4-tetrahydrobenzene is formed, but zinc dust in either glacial or dilute acetic acid gives rise to 3-keto-1:1-dimethylhexahydrobenzene.—A new trinitroacetaminophenol and its use as a synthetical agent: R. **Meldola.** Mononitrodiacetylaminophenol when dissolved in a mixture of fuming nitric and strong sulphuric acids, yields 2:3:5-trinitro-*p*-acetaminophenol, which is remarkably active as a synthetical agent owing to the extreme mobility of one (position 3) of the nitro groups. By the action of various amines on the trinitro-compound substituted benziminazoles are produced.—Pinene nitrolamine: F. P. **Leach.** This nitrolamine and a number of its derivatives are described.—A *pseudo* semicarbazide from pinene: F. P. **Leach.**—Some derivatives of benzophenone. Synthesis of substances occurring in coto bark. Preliminary notice: W. H. **Perkin,** jun., and R. **Robinson.** 2:4:6:3′:4′-Pentamethoxybenzophenone, $(MeO)_2C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$ (pentamethylmaclurin), is obtained when aluminium chloride reacts with a mixture of veratryl chloride and phloroglucinol trimethyl ether in presence of carbon disulphide. 3′:4′-Methylenedioxy-2:4:6-trimethoxybenzophenone,

$$CH_2:O_2:C_6H_3\cdot CO\cdot C_6H_2(OMe)_3$$

(oxyleucotin) was synthesised by treating a mixture of piperonyl chloride and phloroglucinol trimethyl ether in carbon disulphide solution with aluminium chloride. The syntheses of other related products by similar reactions are also described.—The liquid volume of a dissolved substance: J. S. **Lumsden.** Experimental results are recorded which prove that the following law holds, though certain irregularities due to the influence of the solvent exist. When a substance in the liquid state dissolves without change of volume, the same substance when in the state of solid or gas will, when dissolved in the same solvent, change to the volume which the same weight of it would have if it were a pure liquid at the temperature of solution.—A synthesis of terebic, terpenylic, and homoterpenylic acids: J. L. **Simonsen.** These three acids were synthesised from ethyl acetylsuccinate, ethyl β-acetylglutarate, and ethyl β-acetyladipate respectively by means of magnesium methyl iodide.—Influence of light on diazo-reactions, part i.: K. J. P. **Orton,** J. E. **Coates,** and (in part) F. **Burdett.** Solutions of diazonium salts in water, methyl or ethyl alcohol, acetic or formic acid, decompose rapidly on exposure to light, the product of the reaction depending on the solvent.—The viscosity of liquid mixtures: A. E. **Dunstan** and R. W. **Wilson.** Viscosity concentration curves of mixtures of water and sulphuric acid show a well defined maximum point corresponding with H_2SO_4,H_2O, and a minimum corresponding with $3H_2SO_4,2H_2O$.

Linnean Society, December 6.—Prof. A. W. Herdman, F.R.S., president, in the chair.—The physiology of the museum beetle, *Anthrenus muscorum* (Linn.) Fabr.: Prof. A. J. **Ewart.** The mischief wrought by this species in the National Herbarium at Melbourne is great, and is only kept in check by systematic use of a chamber impregnated by the vapour of carbon-bisulphide, in which the plants are placed for several days at a time. The use of corrosive sublimate is not advisable owing to the grave danger to health in a dust-forming atmosphere. The most remarkable feature of the larvæ is their power of feeding on dry material with less than 9 per cent. of water, and yet these larvæ exhibit the usual amount in their structure, averaging 70 per cent. The author suggests that the water may be

chemically derived from decomposition of the carbohydrate food they consume. Bacteria are present in abundance in the alimentary canal of these grubs, and oxidise the carbon of the food where no transpiration of water is possible.—Note on the origin of the name Chermes or Kermes: E. R. **Burdon**. The existence of the same generic name in two families of the Hemiptera is due to the following causes:—(1) that the dye-insect of the oak, *Quercus ilex*, Linn., had been known since the Arab conquest of Spain by the popular name of Kermes all over the south of Europe. (2) That Linnæus, apparently unaware of this fact, put the Kermes dye-insect into the genus Coccus, and employed Chermes as the generic name for another group of insects, amongst which he placed the spruce gall-insect. (3) That Geoffroy, objecting to this misapplication of a well-known popular name, used Chermes as the generic name for the dye-insect which Linnæus called Coccus. (4) That Boitard used the name for the same insects as Geoffroy, but spelt it Kermes. (5) That the majority of workers at the spruce gall-insects have retained the Linnæan name of Chermes, and at the same time Coccid authorities have naturally continued to use the name Kermes for the insect which had popularly been so-called from early times. The author concludes that, in view of the wide acceptance of both Chermes and Kermes, any alteration would only make confusion worse confounded.—Part x. of the reports on Biscayan plankton collected by H.M.S. *Research* in 1900: E. W. L. **Holt** and L. W. **Byrne**. An account was given of the fishes captured. It was remarkable that no fish-eggs or larvæ were taken in any of the thirty-seven hauls of the closing-net which explored the water between 2000 fathoms and fifty fathoms; they appeared to be confined to the upper 100 fathoms, and were rare at the surface. Nine species and six genera were recognisable, the deepest of which was *Gonostoma bathyphilum*, taken in the closing trawl between 2000 fathoms and 1500 fathoms. Several unknown larvæ are described and figured.

Royal Meteorological Society, December 19.—Mr. Richard Bentley, president, in the chair.—The Guildford storm of August 2, 1906: Admiral J. P. **Maclear**. This storm shows some very curious and interesting features in the remarkable violence of the wind, rain, and hail within a small area, and the suddenness with which it burst. There was an area of thunderstorms over the whole of the south of England on the evening of that day. The most violent storm, however, burst over Grayshott, on Hindhead, at 8.20, and pursued a narrow track through Godalming and Guildford to Ripley, five miles north-east of Guildford. The wind was of hurricane force, and blew down an immense number of trees and caused other damage, and also the loss of two lives. The rain, accompanied by large hailstones, was very heavy, as much as 1.17 inches falling at Grayshott in fifteen minutes. There was a magnificent display of lightning.—The metric system in meteorology: R. **Inwards**. The author did not discuss the general question of the advantages of the metric system over that in use by Britain and her colonies and the United States of America, but confined his remarks to the advisability of adopting some uniform system by all the meteorological observers upon the globe.

MANCHESTER.

Literary and Philosophical Society, November 27.—Prof. A. Schuster, F.R.S., in the chair.—Some points of chemical philosophy involved in the discovery of radium and the properties of its combinations: Dr. H. **Wilde**.—A collection of land and fresh-water Mollusca collected by Mr. S. A. Neave in North-East Rhodesia: J. Cosmo **Melvill** and R. **Standen**. The areas traversed by Mr. Neave were mainly the high plateaux and mountainous lands between the Loangwa and Kafue Rivers, at an elevation of 2000 feet to 4200 feet. Mollusca were, in certain places (particularly Kapopo, in the limestone district), plentiful in individuals, but deficient in number of species. Most notable were the large agate-snails (Burtoa, Achatina, and Limicolaria), of which one elegant form, *A. rhodesiaca*, remarkable for its attenuately-fusiform contour, is new to science. *Cleopatra mterizensis*, one of a fluviatile genus, endemic in the African continent, is also until now undescribed, as is an interesting member of the sinistral genus Lanistes, which occurred at Kapopo, and is to bear the name of *L. neavei*, after its discoverer. Only twenty-two species are gathered in all, the majority being already known as natives of German East Africa, the Nyassa district, the neighbourhood of Victoria Nyanza or the Zambezi River. Little specific affinity seems to exist with the Transvaal or South Africa, excepting so far as some widely distributed species, *e.g.* *Melania tuberculata*, Will., and *Physopsis africana*, Krauss, are concerned.

DIARY OF SOCIETIES.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: the Invention of the Electric Telegraph: W. Duddell.

MONDAY, DECEMBER 31.

LONDON INSTITUTION, at 4.—Volcanoes: W. Herbert Garrison.

TUESDAY, JANUARY 1.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: Modern Electric Telegraphs: W. Duddell.

WEDNESDAY, JANUARY 2.

SOCIETY OF ARTS, at 5.—Perils and Adventures Underground (Juvenile Lecture): B. H. Brough.

LONDON INSTITUTION, at 4.—The Fire Belt around the Globe: W. Herbert Garrison.

THURSDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: the Telephone and its Working: W. Duddell.

FRIDAY, JANUARY 4.

LONDON INSTITUTION, at 4.—Earthquakes and Geysers: W. Herbert Garrison.

ROYAL GEOGRAPHICAL SOCIETY, at 3.30.—Japan and the Japanese as I saw them: Miss A. L. Murcutt.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Signalling to a Distance: Early Wireless Telegraphs: W. Duddell.

CONTENTS.

THURSDAY, JANUARY 3, 1907

PLANT DISPERSAL AND KINDRED PROBLEMS

Observations of a Naturalist in the Pacific between 1896 and 1899 By H B Guppy Vol ii Plant Dispersal Pp xxvi+627 (London Macmillan and Co, Ltd, 1906) Price 21s net

FEW of the problems that confront the naturalist are wider in their range of interest than those connected with the origin of the present inhabitants of an oceanic island Such a population is almost always a very mixed one, though it can usually be roughly divided into two classes, the one embracing the aboriginal or endemic element, whilst the other is composed of colonists hailing, it may be, from widely-sundered centres of emigration But closer investigation shows that such a distinction is, after all, not a very profound one The forbears of the endemic groups were themselves at one time colonists, time and circumstance have permitted and encouraged divergent variation, and so new types have arisen The *causes* responsible for the variation itself for the most part elude recognition and their study is the business of the physiologist rather than of the naturalist, but the *effects* may well serve to concentrate the attention of the latter on the larger problems bearing on the nature and significance of adaptation no less than on those more directly concerned with the sources and mode of dispersal of the individual species

Mr Guppy, in his "Observations of a Naturalist in the Pacific," has kept both sets of problems clearly before him, and has produced a book that will deservedly appeal to a wide circle of biologists, and indeed, to all who are interested, not merely in the details, but also in the philosophical aspects of distribution

The author will probably not expect his ideas to command universal assent It is inevitable and indeed desirable, that divergence of opinion should exist as to the true explanation of phenomena which are still but imperfectly comprehended But such dissentience in no way detracts from the value of his work Perhaps the highest praise that can be earned by any contribution to science is to say of it that its facts are really facts, and its theories whatever be their ultimate fate, are stimulants to further research

Although the book before us deals with matters affecting the distribution of plants in general, the subject is more especially considered in relation to the littoral floras of the Pacific islands The author takes as types to illustrate the wider bearings of his own observations the floras of Hawaii, Tahiti, and Fiji He discusses very fully the various causes which in the case of the three island groups chosen have produced results so dissimilar, notwithstanding the equality of conditions which at first sight appears to prevail between them

The keynote of the explanation advanced to account for the facts is to be found in the buoyancy of the seed or fruit But whilst many of the author's conclusions are both suggestive and interesting, it may be doubted whether others will be prepared to accept his views as to the connection between buoyancy and habitat

Put briefly, his position is this The capacity of floating determines the position of those species possessing buoyant fruits or seeds by the river or on the coast Which of the latter stations is actually occupied will depend on the degree of transpiratory activity on the part of the plant, that is to say, on whether it happens to be a xerophyte or not If the former, then it will be chiefly restricted to the coast, but if not it will be precluded from occupying a position that is only suited to plants that can withstand physiological drought, and it will be driven to take up its position by the river or pond Mr Guppy expressly and repeatedly states his conviction that it is not the station which is responsible for the development of buoyant seeds, but that the plants so characterised reach and colonise littoral or riparian stations because they can be distributed to them, in other words, position does not determine buoyancy, but buoyancy determines the station subject to the further sorting out process which is associated with xerophilous or hygrophilous habit

But the author himself shows that seeds or fruits of the same species may exhibit great variation in their power of floatation some sinking at once when placed in sea water, whilst others from the same tree may float without injury for months He goes farther than this, and emphasises the need in making such tests, of taking seeds from plants grown under similar conditions Thus in *Ifelia bijuga* experiment showed that of the seeds taken from a littoral example 70 per cent floated in sea water whilst of those gathered from an inland individual of the same species only 25 per cent were able to swim Several other similar examples could be cited Such evidence would seem, however, to indicate that the environment is not without its direct influence in determining the floatability or the reverse of the seeds, and clearly if this is so natural selection has material enough to work on At any rate one would hesitate before accepting the author's conclusions as to the real relation between buoyancy and station

A very useful account is given of the several structural features to which buoyancy may be due As they are often remarkably simple it seems not unreasonable to think that an experimental study of the direct reaction of the plant to the environment in such cases as these would almost certainly yield interesting and valuable results

The author has some excellent remarks on the nature and origin of adaptive characters and they deserve to be carefully read by members of that large but somewhat careless class of naturalists who imagine that when a structure has been shown to be useful for a particular purpose its occurrence is thereby "explained" Nothing can be farther from the truth, and the more we know of "adaptive" structures the less directly does their origin appear to be related with the function they ultimately dis-

charge One might go so far as to suggest that it is only by accident that a character developed at one period in the life-history becomes of use at another, for such utility almost always involves a change of primitive function that could not have been foreseen at the first appearance of the structure in question Thus to quote the case of the floating mechanism, the stimulus that provokes the formation of air-filled spaces is most often connected with respiration, and they are first "adapted" for this purpose Their subsequent use for floatation is an accident It is true it may be of immense importance to the *species*, but its value could not, so to say, have been foreseen by the individual in which it arises

A chapter on mangroves forms an interesting diversion from the main track of the thesis It is known that curious barren forms of the genus Rhizophora occur in various regions These apparently combine the characters of more than one species, but the suggestion is put forward that they are not hybrids, but represent examples of dimorphism The hypothesis is rather startling, but it is very well worth while testing If it should prove to be well-founded, the investigation would certainly yield results of considerable scientific importance

Limitations of space preclude the possibility of attempting to discuss the great bulk of new and interesting observations that crowd the pages of Mr. Guppy's book, but enough has been said to show that the author has made a very real contribution to biological science J B F

PETROLEUM AND ITS PRODUCTS

Petroleum and its Products By Sir Boverton Redwood Two vols Pp xxxii + 1064 Second edition, thoroughly revised and enlarged (London Charles Griffin and Co, Ltd) Price 45s net

NO harder task exists than to criticise a book with which the reviewer is in complete accord, and so perfect an example of what a book of reference should be as Sir Boverton Redwood's monograph on petroleum and its products, of which the second edition has now been issued, offers no mark for criticism

The ten years which have elapsed since the first edition of this work was published have seen many advances in the industrial use of petroleum products, and a period which has been marked by the growth of the use of liquid fuel from the experimental stage to the important position it now occupies in the principal navies of the world, and the perfection of the internal combustion engine with its widespread application, has brought in its wake so many alterations and modifications in processes that a complete revision, and indeed re-writing, of a very large portion of the book has been necessitated, the two volumes now containing more than a thousand pages.

The first section of the work deals with the history of the petroleum industry, from the use of bitumen in building the Tower of Babel down to statistics as recent as 1904, and this portion of the work is rendered the more valuable by the data being subdivided under the headings of the various countries in which petroleum is found.

The geological and geographical distribution of petroleum and natural gas occupies the second section, which is illustrated by maps of the principal oil-bearing districts, and cross sections of some of the more important oil fields and wells. A consideration of the oil fields of the world naturally leads to the discussion of the chemical and physical properties of petroleum and natural gas, which occupies the third section of the work, and contains a wonderfully complete compilation of the enormous amount of work which has been done on the subject, and which is rendered the more valuable by the references being given for all the works quoted

The next section deals with the much-vexed question of the origin of petroleum and natural gas, and a discussion of the various theories which have been from time to time formulated, and although the balance of evidence is distinctly in favour of the views expressed by Hofer and Engler, as to petroleum being of animal origin, whilst natural gas is a secondary product of the same decomposition, the reader cannot help the conviction that there are many cases in which a vegetable or even inorganic origin might have caused the deposits

The fifth section will be considered by many readers one of the most important in the work, dealing as it does with the methods adopted for winning the crude oil, and much of the practical information as to the methods employed in the American, Canadian, Russian, and other oil fields is founded on the author's own experience

The important subject of refining the oil, which occupies the next section, covers not only the general methods employed, but also the details of the methods of manufacture adopted in America, Russia, and elsewhere, and is enriched by numerous references and extracts from the work of Engler and other Continental authorities too little known in England

The shale oil industry, being of British origin, claims a large amount of interest, and the struggles of James Young in founding it on its present basis form a fitting introduction to the seventh section, dealing with shale oil and allied industries, whilst an able section on the transport, storage, and distribution of petroleum ends the first volume of the book

To the chemist the second volume is even more interesting than the first, as the reader is at once plunged into the methods adopted for the testing of crude petroleum and the many products obtained from it, and especially interesting is the historical account of the early legislation with regard to the flash point, and the part played by Sir Frederick Abel and the author in fixing the flash point at its present value This section also contains a full account of the beautiful method of testing for petrol vapour and other inflammable vapours in air devised by Prof Clowes and the author, which depends on the fact that a hydrogen flame of fixed dimensions burning in air containing a small proportion of inflammable gas or vapour is seen to be surmounted by a small cap or halo, the size of which indicates the amount of in-

flammable vapour present in the air long before the mixture becomes itself inflammable

In these days, when petroleum spirit is so largely stored and used for motor purposes, and when so many steamers are engaged in the oil trade, tests capable of revealing any dangerous leakage of vapour are of the greatest importance, and the "flame cap" offers a certain method of detection

The tenth section of the work deals with the uses of petroleum and its products, and commences with a full description of the various types of oil lamp fitted for the consumption of mineral oils, and a full discussion of the dangers due to them A careful study of this portion of the section would do much to disabuse the minds of that portion of the British public which has been lately clamouring for an increase in the flash point, with the idea that this would minimise the danger of the oil lamp, and especially may the following paragraph be recommended to its notice —

"Experiments have demonstrated that the burning of an oil of comparatively high flashing point is more likely to cause heating of the lamp than the use of an oil of comparatively low flashing point, in consequence of the higher temperature developed by the former and of the greater difficulty with which some oils of that description are conveyed to the flame by the wick It therefore follows that safety in the use of mineral oil lamps is not to be secured simply by the employment of oils of comparatively high flashing point (or low volatility), and that the use of such oils may even in certain cases give rise to dangers, which are small, if not entirely absent, with oils of comparatively low flashing point"

The use of oil in spray lamps, the so called "air gas," the enrichment of coal gas by carburetting carburetted water gas, oil gas, and natural gas are here all described and discussed, whilst the use of liquid fuel leads to a full description of the various methods which have been employed, but unfortunately the author's position as leading adviser on petroleum to the Admiralty has prevented his giving any extended notice of the advances which have made the liquid fuel installations of the British Navy the finest and most successful in the world The section closes with a short account of the principles upon which petroleum engines are constructed, but, as the author points out, the motor-car industry and consequent development of petrol engines has assumed such vast proportions that it now possesses a voluminous literature of its own, which has far exceeded the scope of the present work

A section on the statutory, municipal, and other regulations affecting petroleum and its products brings the work to a close, whilst a voluminous appendix and excellent index add to its value So full are the references to all original memoirs noticed in the book that a bibliography of the subject at first seemed hardly necessary, but Messrs W H and L V Dalton have compiled one which will rejoice the heart of every student of the subject

The petroleum industry is indeed fortunate in possessing such a work of reference, and Sir Boverton Redwood has done the world a great service in providing it

RECENT ADVANCES IN PHYSIOLOGY

Mercers' Company Lectures on Recent Advances in the Physiology of Digestion By Prof Ernest H Starling, F R S Pp x+156 (London Archibald Constable and Co, Ltd, 1906) Price 6s net

As time advances it becomes ever clearer to many of those whose business it is to consider the manner in which university teaching should be carried on that the usual systematic course of lectures on the whole range of any of the larger divisions of human knowledge is an anachronism surviving from the time when there were no good text-books, and knowledge had to be conveyed directly from lecturer to student

In all the medical schools of the country at the present day, professors or lecturers hold appointments which entail upon them the duties of lecturing over the whole of such subjects as systematic medicine, systematic surgery, physiology, or pathology and bacteriology It is to be hoped that within the progress of a single generation such appointments may have ceased to exist, and that the student of the future may be able to give to the laboratory or the clinique that large section of his time which is at present misspent in the lecture-room What applies to the long lecture course, too often extending over two whole winter sessions applies with equal or greater force to the text-book written upon the whole range of a large subject

The present volume forms a delightful and refreshing contrast to any such wearisome compilation, it consists of a short course of ten lectures given by a master worker to his students, chiefly upon the work done in his own laboratory by himself and his colleagues This appears to the writer to be the ideal of what a lecture course should be, namely, something stimulating to enthusiasm and capable of sending the listener into the laboratory with the desire to work and learn more - a contrast in every sense to the mechanical lecture which must wade monotonously through everything, and, gramophone like, repeat from year to year the phrases and the stereotyped long-dead thoughts of text-books devised on the same mechanical system It is to be hoped that such special courses of lectures and specially written text-books, given and written by those in living touch with the subject in hand, may soon replace the universal lecturer and universal text-book

Naturally, in order to present in intelligible form the work of any one laboratory, it is necessary to place it in its appropriate setting to the work of others which has preceded it and led up to it, and to give for completeness contemporary work being done elsewhere, but such an account will be given by one who has gained a complete mastery of it at first hand for the purposes of his work, and will always be real, live, and interesting as compared with the account of one who has read it only to compile a text book or give a course of lectures

These ten lectures on recent advances in the physiology of digestion are an example of this and are full of interest from start to finish, by which is not meant that one follows the author in a quiescent state of en-

joyment and contented agreement from lecture to lecture, for, otherwise, one is more inclined to be continually stopping and arguing by the way, but at the same time it is felt that one is being thoroughly instructed upon the present state of knowledge of the subject by a master worker who has himself been engaged upon the problems involved.

The book is a record of a course of lectures given in recognition of a generous gift by the Mercers' Company in aid of the work of the physiological department at University College, London; a similar course is to be delivered each year, and it is to be hoped they will also be published.

This first course treats of the foodstuffs and their changes during digestion, the mode of action of ferments, secretion of saliva, digestion in the stomach, pancreatic secretion, changes in the pancreas during secretion, the properties of the pancreatic juice, the bile, the intestinal juice, and the movements of the alimentary tract. It is the "growing border," as the author himself styles it, of these important subjects which is mainly treated of, and to take up and criticise all the new work and theories involved would occupy more space than the little volume itself.

There is, however, one view of general interest with regard to the action of ferments or catalysts which here, as elsewhere, scarcely receives the consideration it deserves, and appears to be accepted without criticism. This is the law of Ostwald, that in order that an intermediate compound may be regarded as a sufficient explanation of a catalytic process, it must be first demonstrated that the rapidity of formation of the intermediate compound, and the rapidity of its decomposition into the end-products, are *in sum* greater than the velocity of the reaction without the formation of the intermediate body.

The error in this statement is the implied supposition that these three velocities are constants, in which case the law would follow—but a reaction is not constant throughout its range, beginning with high velocity and decreasing as the equilibrium point is approached. Further, for the reaction to run, all that is necessary is a potential quantity of the intermediate body, which would tend to be formed with very high velocity, so that the necessary and sufficient condition is that the intermediate body should decompose to form the end-products with greater velocity than does the initial substance when present alone. The greater velocity is obtained because the intermediate body formed with the catalyst gives a path of less resistance, so that the same chemical potential difference leads to equilibrium in a shorter time.

BENJAMIN MOORE.

SCIENCE AND ROAD-METAL.

Attrition Tests of Road-making Stones. By E. J. Lovegrove. With Petrological Descriptions by Dr. John S. Flett and J. Allen Howe. Pp. xx+80. (London: The St. Bride's Press, Ltd., n.d.) Price 5s.

MR. LOVEGROVE'S attrition-tests have been carried out systematically for some years past in the modest but unique museum of the Hornsey Town Council, an institution devoted to the useful arts of building-construction, sanitation, and public works in general. Here the compact machine figured on p. vii makes itself heard from time to time, when the stones undergoing the tests are lifted by the internal flanges of the three revolving cylinders, and fall a distance of eleven inches in their cast-iron prisons with painful iteration. After 8000 revolutions, what is left of them is taken out, and the chips and dust broken from them are separately estimated. The production of chips, as Mr. Lovegrove points out (p. vi), is an indication of brittleness, but may not be injurious to a road. The dust, which is determined in a dry experiment and also by one in water, is so much pure waste when formed on a road-surface or in the layer of macadam itself. The melancholy and pebble-like appearance of certain stones after they have suffered from Mr. Lovegrove's inquisition can be well seen in the Hornsey Museum, or in Figs. 77 and 78 of the present volume.

The director of the Geological Survey of Great Britain has encouraged this excellent series of experiments by forming a collection of tested stones in the Museum of Practical Geology in Jermyn Street, while Dr. Flett and Mr. Howe have supplied Mr. Lovegrove's volume with petrological descriptions and photographs from microscopic sections. Indeed, these valuable additions form the greater part of the book, though the eye is unpleasantly attracted from them to the large-type advertisements which are distributed throughout its pages. Mr. Howe's "general conclusions" will be read with special interest, and we cannot help quoting the following from them:—(P. 67) "The hardest and toughest stones combine *abundance of a hard mineral—e.g. quartz—with a dense fine-grained texture.*" (P. 69) "The very best rocks in these tests are altered rocks, and as a general rule a certain amount of alteration of the felspars seems to be an advantage. The reason for this is that the alteration produces a *number* of mineral units where formerly only *one* existed; in other words, the texture is made finer, and often the interlocking of the grains is made more complete." (P. 70) "*Fineness of grain* makes for toughness in all classes of stone."

The alteration of basic felspars of course often results in the crystallisation of granular minerals of hardness superior to that of the original material. Mr. Howe notes, moreover (p. 60), that uralitised augite is an advantage in dolerites, while augite altered to chlorite and calcite is naturally defective. Microscopic examination probably assists more in the case of rocks of the diorite, dolerite, and diabase type than in any other series, and this alone makes the practical field of the petrologist a wide one. The engineer and the experienced user of roads will, of course, recognise other grounds for the selection of this or that stone than the results of the attrition-test alone. Flints, for instance, which stand out well in the tests, are unsuited for countries with dry summers. Well-rolled limestone, on the other hand, where dry days are liable to follow dewy nights, as in the Apennines, may provide an admirable and cement-

like surface For ordinary moist climates, however, these tests serve as a clear condemnation of all limestones Even the gritty Kentish Rag (p 45) comes out badly, though, in combination with the ferruginous sandstones of our Lower Greensand, it has been known to make a road that held well together in dry seasons

The question of composite roads would be an interesting study in itself Materials showing great differences under the attrition-test should, of course, not be used in association, but roads made of mixed gravel taken out of streams show good results in many parts of Europe Similar material is usefully supplied by the glacial gravels nearer home Teachers of practical geology, as well as all county and borough surveyors, will be grateful to the three authors for providing a remarkably cheap, clear and thoughtful treatise on a subject that the whirligig of time has again made of national importance G A J C

DYNAMO DESIGN

Elementary Principles of Continuous Current Dynamo Design By H M Hobart Pp x+220 (London Whittaker and Co) Price 7s 6d net

IT is scarcely necessary at this date to recommend a book by Mr Hobart on the design of direct current dynamo machines, it is safe to say that any production by this author will repay the study of practical men, and the present book forms no exception

The contrast presented between a volume setting forth the results of the practical experience of a man engaged in actual work and a book evolved out of the inner consciousness of a man who has access only to the theory of the subject is very striking Books of the former class are comparatively rare, and are correspondingly valuable

Dealing in a general way with Mr Hobart's work the first point that strikes one favourably is the emphasis laid on the necessity of a large amount of application on the part of the student of the principles and methods set forth These principles and methods must be regarded as the framework on which a designer is to build, and it is folly for him to assume that he is acquainted with the subject unless and until he has gone a long way in completing the structure by his own labour The value of the book lies in the essential soundness of this framework more particularly of the fundamental ideas on which it is itself based than on the framework itself The commercial point of view is not instinctive with designers, and it is of the greatest importance that it should be acquired as soon as possible For this reason Mr Hobart has done well to lay stress on the necessity of judging every design by taking into account its first cost as well as its technical merits

Regarded in this way, the book consists of a series of statements explaining the way in which a dynamo should be considered as a successful machine or the reverse, and of a short account of several methods whereby the designer may himself estimate the first cost

After preliminary chapters on what may be called the practical theory of the continuous current dynamo, Mr Hobart deals at length with those considerations which form the limits in the design, namely, heating, sparking, and efficiency Numerous constants and formulæ are given, and miscellaneous information from which efficiencies can be calculated The sparking data are, naturally, based on the method of reactance voltage, introduced some years ago by the author and Mr Parshall, although a long list of references is given to those who have contributed to the theory in recent years This method, or some modification thereof, is so widely used that there is no necessity to describe it here The constants for dealing with the heating and the efficiency are, perhaps, the least praiseworthy part of the book, or rather not so much the constants as the general method The treatment in both cases seems somewhat arbitrary, for instance it is not absolutely certain that the rise in temperature of the armature is proportional to the total watts lost—copper plus iron loss—divided by the area of the cylindrical surface Again, the method of estimating the iron loss in the armature is distinctly rough This point has been debated at considerable length in the columns of the technical Press, but in the present writer's opinion there are other methods which certainly give better results The calculation of the bearing friction and windage is referred to a single curve giving the relation between this loss and the value of D^2L at the speed of 1000 revolutions per minute, but there seems to be no indication as to how the loss varies with the speed whether in direct proportion or as the 1 5th power of the speed

These slight discrepancies somewhat diminish the value of the book as a work of reference, but the essential feature of the book consists, as already stated, in the enforcement of a general grasp of the whole problem, commercial as well as technical

The book contains a large number of tables in which the various calculations are set out, some are filled in and others are left blank for the convenience of the student It will thus be seen that this is a work which can be thoroughly recommended to the student and the designing engineer alike

OUR BOOK SHELF

Irrigation with Surface and Subterranean Water and Land Drainage By W Gibbons Cox Pp viii+297 illustrated (Sydney Angus and Robertson, 1906)

THE author of this book has been engaged for many years in Australia in water supply and irrigation works There are vast areas of land in that country the soil of which is of the highest fertility but is barren and comparatively useless because of periodical aridity The problem of irrigation of the land from the rivers and creeks that flow at times through these districts, and form inexhaustible accumulations of underground water, is treated fully and practically according to the latest and most approved methods

With all its natural wealth and resources Australia is subject to the great drawback of occasional droughts of greater or less severity The consequences of one of these droughts is thus graphically described —"The natural water supply of the dis-

trict had become exhausted by use and evaporation, and the livestock were dying, while the women and children were beseeching the conductor of the Government water train—sent for the use of the line repairers' camp—to give them water Along the dried-up beds of creeks and lagoons, miles of bleached bones of dead cattle and sheep lay exposed to view The poor brutes, in their intense suffering, had ventured for a drink of the last water left, and sinking down, weak and helpless, had perished in the vain attempt to quench their dying thirst Overhead a scorching sun was shining like molten brass, and the heat waves of the atmosphere rendered the eyesight powerless to define objects at a distance, all vegetation lay withered The birds dropped gasping from the trees The experience of that drought was sufficient to impress any man, engineer or other, with the need of finding a remedy "

The process of sinking artesian wells for irrigation is fully and practically described, from those of shallow depth that can be sunk by hand labour, to the more extensive and deeper sinkings that penetrate to a depth of 6000 feet, and require the use of a 50 h p engine, and cables for raising and lowering the drills which weigh 6½ tons, the cost running up to 8000*l* The question of irrigation and the distribution of water, treatment of alkaline water, and drainage are dealt with in separate chapters In the appendix the statistics are given of the public artesian borings with their depths and yield It shows that these range from 46 feet in depth and a yield of 9000 gallons a day to 4086 feet and a yield of 1,000,000 gallons a day, the highest temperature of the water flowing out being 135° F

This book should be of great service to colonists settled in arid districts

Through the Telescope By James Baikie Pp xv+292 (London A and C Black) Price 5s net

THIS handsomely illustrated volume bears the impress of having been written by a practical observer who has suffered all the little worries and difficulties inevitably encountered by the amateur astronomer in his days of inexperience and meagre instrumental equipment Whilst treating of the sun, moon, planets, &c, in special chapters Mr Baikie writes of things he has observed and of difficulties he has overcome

The two opening chapters deal with the telescope, first from the historical, secondly from the practical standpoint The latter may be heartily recommended to beginners, who by carefully digesting and mentally assimilating it may save themselves much worry and, mayhap, expense We question, however, whether some of the advice is not a little too detailed, some things are better left to actual experience, others to common sense, *e g* the instruction on p 44 for the observer to wrap up well and keep his feet warm

The phenomena of the celestial bodies are described in plain language, interspersed with practical hints as to observing them, which cannot fail to help the beginner in "star-gazing," and, if he follows the author's advice, in the specialised study of some particular class of objects

The historical narrative in each case is lucid and instructive, although there are notable omissions of important work The two appendices containing the designations and brief descriptions of "lunar formations" and "double stars, clusters and nebulæ which may be fairly well seen with instruments up to 3 inches in aperture" form a valuable addition to this volume W E R

The British Journal Photographic Almanac and Photographer's Daily Companion, 1907 Edited by George E Brown. (London Henry Greenwood and Co, n d)

THIS annual is so well known to our photographic readers, that in dealing with the present issue we can say that the volume, as in former years, maintains its high position as a mine of photographic information In fact, its presence in every studio becomes year by year more necessary, for as a book of reference on almost every photographic manipulation it is most valuable

In the present issue one of the features which has attracted our special attention is the excellent editorial article bringing together brief summaries of the various three-colour photographic printing processes To-day the subject of printing in colours is so absorbing the time of many ardent workers that such a survey of the various processes in use is very opportune Another section which will be read with much profit is the epitome of progress Here we have brought to our notice a classified summary of the advances made in the numerous branches of photography during the past twelve months The matter is arranged under various subheads, such as "Apparatus and Equipment" "Photographing Various Subjects," "Negative Processes," "Printing Processes," and "Colour Photography," so that for purposes of reference any particular subject can be easily found As in former years, the formulæ for the principal photographic processes and of the principal plate and paper makers, useful miscellaneous information, and numerous tables complete the volume Very complete indices add greatly to the utility of the work

British Flowering Plants By W F Kirby Pp viii+215 (London S Appleton, 1906) Price 5s net

THERE are many pleasing features in this small book that treats of flowering plants in a popular way The illustrations, if a trifle over-coloured, are characteristic, and the author describes the plants in a sufficiently technical manner to permit of their identification, on the other hand, the book hardly gives an adequate idea of the importance of the different orders, and so many foreign plants are selected for illustration that the most popular method of determination is not provided for commoner British plants

The title furnishes no indication of the most useful information in the book afforded by the numerous notes which the author has added from his own special branch of natural history, relating to the insects that frequent plants either for destruction or indirectly for construction This information is of value alike to the botanist and the entomologist, and the observer who proceeds to verify the references to plant-visiting insects is likely to obtain a deeper insight into the structure and ways of flowers than is necessary for mere identification The introduction is not a botanical success and requires careful revision

The Fauna of British India, including Ceylon and Burma Coleoptera Vol 1 (Cerambycidæ) By C J Gahan Pp xviii+329 (London Taylor and Francis, 1906)

THE series to which this volume is the latest addition is being published with the authority of the Secretary of State for India in Council under the editorship of Lieut-Colonel C T Bingham The present book is only the first part of the contemplated volume; another part, which will give an account of the Lamiidæ, is to be published later Other volumes on Indian Coleoptera will follow in due course

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radium and its Disintegration Products

IN NATURE of December 6, 1906, Mr. H. S. Allen has suggested that the difficulty encountered in introducing actinium with its four α-ray products between uranium and radium can be removed by assuming that the α particle is one-half of the helium atom, and he has applied this suggestion in a table showing six α-ray changes between uranium and radium. There would appear to be two serious and insurmountable objections to this view, however, viz. (1) the continuation of the same line of reasoning would lead to the assumption of no less than seven α-ray changes between radium and its final disintegration product, lead, while but four are known, and (2) the activity of the actinium in equilibrium with radium in minerals is entirely too low to permit any such conclusion.

That lead is the final disintegration product of uranium is, I believe, conclusively shown by the fact that in unaltered *primary* minerals from the same locality the amount of lead is proportional to the amount of uranium in the mineral, and that in unaltered primary minerals from different localities the amount of lead relative to uranium is greatest in the minerals from the locality which, on the basis of geological data, is the oldest.

In the case of a non-emanating, radio-active mineral containing no thorium, in which there is reason for assuming that the elements of the uranium-radium series have reached a state of equilibrium, the activity of the mineral in extremely thin films measured in an electroscope with a large ionisation chamber is about 5·3 times as great as the activity of the uranium present in the mineral. The activity of the radium itself is about 0·52 of the activity of the uranium, and the activity of the radium products of rapid change together about 2·4 times that of the uranium. The activity of the radium F (polonium) is probably about 0·55 uranium, and is certainly not less than 0·5. The combined activity of the uranium, the radium and the radium products is therefore about 4·5 times the activity of the uranium alone. This leaves an activity of only 0·8 that of the uranium which can be attributed to the activity of the four α-ray products of actinium. It was the knowledge of the approximate value of this factor which led Prof. Rutherford and the writer to conclude (*Amer. Jour. Sci.*, xx., 56, 1905) that actinium was not a direct product of uranium in the same sense as is radium.

The ranges of the four α particles expelled by the actinium products have been determined by Hahn, and the average range of the four is 5·6 cm. The range of the α particle from radium itself is 3·5 cm. according to Bragg and Kleeman. If the particles are similar we would expect that the average particle from the actinium products would produce about 1·6 times the ionisation of the particle from radium. Since the activity of radium itself is 0·52 times that of the uranium in the mineral, the activity of the four actinium products might be expected to be 0·52×1·6×4=3·32 uranium. The number actually found, as has been stated above, is only 0·8 uranium, or one fourth of this number.

It will be noted in the above that the activity of the uranium is about twice that of the radium present, which is in good agreement with the conclusion of Moore and Schlundt that there are two α-ray changes in uranium if it is assumed that the average range of the two uranium particles is about 3·5 cm.

Although speculations of this sort are of doubtful value, the following suggestion may be sufficiently interesting to warrant its intrusion:—if the two changes in uranium and the five changes in radium are each assumed to take place with the expulsion of *four* α particles and the four changes in actinium with the expulsion of only *one* α particle each, the conditions required by the relative activities of the various substances would appear to be fulfilled, and if, moreover, the mass of each α particle be taken as 1, then the indicated atomic weights of the successive elements are in fairly good agreement with the accepted values. We have then uranium=238·5, actinium=230·5, radium=226·5, and radium F (lead)=206·5. In making this suggestion I fully appreciate that I am taking liberties with the accepted value of e/m for the α particle.

It is of further interest to note that the activity of pure radium, calculated from the relative activity of the uranium and radium in minerals and the relative quantities present (Rutherford and Boltwood, *Amer. Jour. Sci.*, xxii., 1), is indicated as about $1\cdot4\times10^6$ times that of uranium, and the activity of pure radium bromide containing the equilibrium amounts of emanation and products of rapid change as about 3×10^6 times uranium.

BERTRAM B. BOLTWOOD.

Sloane Laboratory of Yale College, New Haven, Conn., December 17, 1906.

The α Rays

THE α rays from radium appear to start life without electric charge, and subsequently become charged owing to collisions with the gas molecules they strike in their path. It seems, therefore, worth while inquiring what their behaviour would be if they were liable to become discharged again at a later collision and to go on repeating this cycle during the ionising portion of their path. Very possibly the α particle is capable of losing more than one electron, in which case it would seem certain that it will have a greater charge at some portions of its path than at others. Looked at in this way the problem is a statistical one of considerable complexity, but my point of view will be sufficiently well illustrated by considering the average α particle to behave as if it had the following constitution. For a distance x of its path it possesses an electric charge e. This is succeeded by a distance x' during which its electric charge is e'. This is followed by a distance x with charge e, then a distance x' with charge e', and so on, repeating indefinitely. Let the particle have a mass m and initial velocity v_0, then confining our attention to a portion of the path so small that v_0 is not appreciably diminished by the collisions which occur, it is easy to show that the quantity measured by the electrostatic deflection as mv_0^2/e would really be $\frac{mv_0^2(x+x')}{ex+e'x'}$, whilst the quantity measured by the electromagnetic deflection as mv_0/e would be $\frac{mv_0(x+x')}{ex+e'x'}$. Thus the measurements would give v_0 correctly, but the quantity denoted by e/m would be $\frac{ex+e'x'}{m(x+x')}$. It is evident that the apparent value of e/m would be independent of the pressure at which the measurements were made, since change of pressure changes both x and x' in the same ratio.

It is interesting to see what would happen if the α particle were *uncharged* during one series of portions of its path, and carried the ordinary electrolytic unit of charge e during the alternating portions. If the alternate stretches were equal, this is what would be obtained if it were an even chance whether the α particle escaped with or without a charge after each encounter. In this case we should have $x=x'$ and $e'=0$, and the measured e/m would really be $e/2m$. On this view Rutherford's measurements would indicate that the α particles are hydrogen atoms with the normal charge instead of helium atoms with twice that charge.

It may well be that it is a matter of chance whether the atom struck or the α particle retains the positive charge after an ionising encounter, but I do not wish to imply that this warrants the conclusion that the α particle is a hydrogen atom. If we accept this conclusion we find ourselves face to face with serious difficulty in finding a place for helium in the story of radio-active change, but even if the α particle turns out to be a helium atom it is possible that its charge might vary periodically in something like the manner indicated. In this case the average charge would have to be twice the electrolytic unit.

This kind of view has the advantage of affording a

reasonable explanation of why the α particle ceases to produce ionising and other effects at a stage when it possesses a much greater amount of energy than that which is known to be required by a positive ion to produce other ions by collision These effects would cease when the uncharged particle was no longer able to become ionised by colliding with a neutral atom The energy (about 10^{-8} ergs) which it then possessed would represent the minimum energy which an uncharged particle must possess in order to shake out an electron on collision with a neutral atom

Even if these speculations are ultimately disproved by the facts, it is interesting to note that, with such a constitution for the α ray, the experiments would measure the velocity correctly whereas the mass, and therefore the kinetic energy, would be erroneous to the extent indicated

Princeton, N J, U S A O W RICHARDSON

The Effect of Radium on the Strength of Threads

WE have carried out some experiments with cotton threads in continuation of those described by Miss Martin and one of us in NATURE of August 17, 1905 The following is a summary of the results obtained —

No difference in the effect was found when the emanation was continuously removed during the exposure by a current of air The same negative result followed an experiment in which it was sought to remove oxygen and moisture from the neighbourhood of the threads by enclosing radium and threads along with phosphoric anhydride in a tube from which the air was exhausted, some metallic sodium being afterwards heated to fusion in a side tube

When threads or a piece of filter paper, after exposure to radium are dyed with methylene blue, the exposed part is found to take a deeper colour than the rest This is given as a test for the presence of oxycellulose

A series of three-day exposures was made at increasing distances from the radium The effect was found to become inappreciable at 18 mm distance When the weakening produced was plotted against distance, the curve showed a corner at 9 mm, suggesting the similar feature found by Prof Bragg and others on the ionisation curves of α rays to mark the end of the effective range of one set of rays

A comparison under the microscope of the broken ends of exposed and unexposed threads showed that the fibres in the former case were straight up to their ends, while the unexposed fibres were curled back on themselves This would indicate a loss of elastic quality through the action of the

J L McKEE
W B MORTON

Qu[illegible] [illegible]elfast, December 27, 1906

T[illegible] the Sea Coast by Earthquakes

[illegible] long discussed by geologists concerning the u[illegible] the land by earthquakes has been impressively [illegible] by recent events In the San Francisco *Argonaut* of November 3 1906, Prof H D Curtis, of the D O Mills Expedition of the Lick Observatory at Santiago Chile reports that the harbour at Valparaiso is now 10 feet shallower than before the earthquake of August 16 1906, and he concludes that the movement was mainly vertical In the Bulletin of the Geological Society of America for May 1906, Messrs Tarr and Martin give a memoir on the changes of level at Yakutat Bay, Alaska, produced by the great earthquake of September 3–20, 1899, two of the most terrible shocks of which occurred on September 10 and 15 The investigators prove conclusively that an uplift occurred extending along the whole Yakutat coast for more than a hundred miles, the maximum movement in Disenchantment Bay being 47 feet 4 inches Uplifts of 7 feet to 20 feet were common, while slight subsidences also occurred in a few places

In view of these facts how can anyone claim that the earth is entirely solid and deny the vertical movement of the land under earthquake forces as is done by Prof Suess in his great work on "The Face of the Earth"?

T J J SEE

U S Naval Observatory Mare Island, California, December 8, 1906

THE observations of Messrs Tarr and Martin in Yakutat Bay undoubtedly form a valuable addition to the knowledge we possess respecting sudden adjustments in the earth's crust

In September, 1899, a portion of the west coast of Alaska was shattered Fault lines were created or extended, and the displacements along these lines have been measured On January 31, 1906, off the coast of Columbia, and on April 18 of the same year in Central California, rock movements similar to those at Yakutat were recorded Every world-shaking earthquake—and there are about sixty of these per year—is an announcement of a molar movement We do not know the magnitude of the masses involved, but from measurements like those made by Messrs Tarr and Martin we may estimate them as being represented by one or two million cubic miles of rocky material

J M

Emerald Green Sky Colour

THE account of the colour of the sky on December 10, 1906, sent by your correspondent from St Moritz closely resembles an experience of a friend and myself on December 27

We were returning from a geological ramble to the west of Crediton, in Devonshire, and were walking eastward, while behind us and gradually overtaking us there had been for several hours a thick snowstorm which later on was to envelop us Between three and four o'clock in the afternoon we remarked the peculiar appearance of the sky, in your correspondent's phrase there was "instead of the usual blue a fairly large expanse of vivid emerald green" I may add that the ground was everywhere white from previous snow

It will be seen that the conditions in Devonshire on December 27 correspond as regards time of day, point of compass, and state of atmosphere with those observed at St Moritz on December 10

With J W Noble I shall await with much interest the explanation F G COLLINS

Exeter

Perception of Relief by Monocular Vision

THE following fact seems to show that the aperture of the pupil plays an important part in the perception of relief by monocular vision

When a polyhedron made of wire is looked at through a small pin-hole pierced on a piece of card and the pin hole is moved about slightly the polyhedron seems to rotate a little about an axis perpendicular to the direction of motion of the pin hole The effect is most remarkable by lamplight, when the pupil is more dilated than it is in broad daylight T TERADA

Science College, Imperial University, Tokyo, November 15

THE GEOLOGY OF THE GERMAN ANTARCTIC EXPEDITION[1]

THE most striking geographical achievement of the German Antarctic Expedition was its determination that Antarctica occurs farther north in western Wilkes Land than had been inferred by some authorities from the work of the *Challenger* Prof von Drygalski and his comrades have re-established faith in Wilkes's Termination Land, as from their Kaiser Wilhelm Land they saw high land to the north-east, only about one hundred miles from the site assigned by Wilkes to his Termination Land The most fully investigated locality in the newly discovered Kaiser Wilhelm's Land is the Gaussberg, a basalt mountain on the southern shore of the bay in which the *Gauss* reached its farthest south

[1] "Deutsche Südpolar Expedition 1901–1903" Edited by Erich von Drygalski II Band Kartographie Geologie, Heft I Pp 87, 1 map, 8 plates. (1) E von Drygalski Der Gaussberg, seine Kartierung und seine Formen (2) E Philippi Geologische Beschreibung des Gaussberges. (3) R Reinisch Petrographische Beschreibung der Gaussberg Gesteine (Berlin G Reimer, 1906) Price 18 marks

The first part of the second volume of the expedition reports is devoted to a full description of the geography and geology of the Gaussberg. It includes three memoirs. A detailed account of the geography of the mountain is given by Prof. von Drygalski, in which he describes its form, position, and glaciation. The most interesting part of von Drygalski's report deals with the glaciation and the forms of the mountain. The inland ice from Antarctica abuts against the southern slope of the Gaussberg, although as a rule its junction with the inland ice is hidden by ice of local origin. The mountain is 370 metres in height, and it was at one period completely over-ridden by ice from the south, and the admirable photographs which accompany Dr. Philippi's report illustrate the subdued glaciated contours of the whole mountain. Some moraines occur on it, and indicate transport from south to north.

The valleys upon the flanks of the Gaussberg are not due to erosion, but are depressions between the lava streams or along lines of rapid weathering. In his description of the mountain, Prof. von Drygalski obviously writes with great restraint to prevent infringing on the geological report contributed by Dr. Philippi, whose memoir is accompanied by a series of excellent photographs of the mountain, its moraines and its lavas. The whole mountain is composed of volcanic rocks, which are described in full petrographic detail, accompanied by analyses and illustrations, by Dr. R. Reinisch, of Leipzig. The rocks are leucite-basalts and leucite-basalt tuffs, rich in glass. The only other indigenous rocks occur as inclusions in the lava; they are nodules of olivine and fragments of pyroxene-gneiss and pyroxene-granite, which appear to indicate that a platform of plutonic rocks occurs at a comparatively slight depth below the basalts.

FIG. 1.—Edge of the Inland Ice and Moraines at the north western corner of the Gaussberg.

The age of the mountain is doubtful, but appears to be late Cainozoic. Dr. Philippi suggests that the eruptions may have begun in the Pliocene, and, in his opinion, they were either late Pliocene or Pleistocene. The local glaciers Dr. Philippi describes as comparatively unimportant in their development. Erratic blocks from the inland ice that once covered the whole mountain are scattered to its summit. The erratics include boulders of granites, gneiss, amphibolites and other crystalline schists, with some quartzites, sandstones, and conglomerates. They indicate the continental structure of the land to the south. The section of Dr. Philippi's report which is probably of most general interest discusses to which of the two coastal types this land belongs. According to Reiter's well-known suggestion, Wilkes' Land is of the Atlantic type, while Victoria Land, as the continuation of the New Zealand line, is of the Pacific type. The evidence available from Cape Adare and Kaiser Wilhelm Land suggests that all the intervening coast is of the Atlantic type. According to Dr. Philippi, Victoria Land is the same. His conclusion rests on two considerations. Firstly, Victoria Land is a plateau land, and when Suess originally distinguished the Atlantic and Pacific coast-types he regarded coastal plateaus as confined to the Atlantic type. The coast of northern Queensland is, however, in part a plateau edge, but it may be retained in the Pacific type, as its characters have probably been determined by a succession of step faults parallel to the coast, a structure which Prof. Suess describes as characteristic of the Pacific type.

No doubt these inner step-faulted coasts of the off-lying seas of the Pacific are younger than the outer folded coast of the main ocean, and it may be convenient to separate them as secondary Pacific coasts. If so, then Victoria Land may be described as having a secondary Pacific coast, like the southern end of New Zealand and the eastern coasts of Australia, and the outer folded Pacific coast may then have passed from the middle of the South Island of New Zealand eastward towards Graham's Land along a line which is still unknown, and has perhaps been completely destroyed.

Unless the Pacific coast type is to be so re-defined as to assign an Atlantic structure to much of the Pacific coast, no adequate tectonic reason has been yet advanced for the removal of Victoria Land from the Pacific group. The second argument for this step is petrographic. Becke and Prior have both suggested that the Pacific and Atlantic types of coasts are characterised, not only by different tectonic structures, but by different groups of volcanic rocks. The volcanic rocks erupted along the Pacific folds are richer in silica, alumina, soda, and magnesia, and the volcanic rocks discharged from the fractures along the Atlantic shores are richer in potash, lime, and iron oxides. The characteristic volcanic rocks of the Pacific are rhyolites, dacites, andesites and acid basalts. Those characteristic of the Atlantic are trachytes, phonolites, tephrites, and basic basalts. The affinities of the volcanic rocks of the southern end of New Zealand and of Cape Adare are with the Atlantic group. As a rule, the distribution of Becke and Prior's petrographic types coincides to a remarkable extent with Suess's two tectonic divisions of the coasts of the world, but the petrographic and tectonic features do not appear to coincide universally, and it is doubtful whether the former is as suitable a taxonomic character as the other.

The Gaussberg area, situated as it is at the western end of Wilkes Land, is of such special interest that it is unfortunate that circumstances prevented the German explorers from reaching a wider extent of land; as these memoirs show the high quality and thoroughness of their work.

J. W. G.

COTTON CULTIVATION IN THE UNITED STATES OF AMERICA

A RECENT event the results of which may be of far-reaching importance was the visit of the commission appointed by a number of representative cotton-spinners "to make inquiry on the spot so as to ascertain, as nearly as possible, the cost of growing cotton, and the economic conditions under which it is produced in the cotton belt of the United States of America, also to investigate the methods of ginning, baling, marketing, and transport of the product"

The report of the commissioners is of great interest as affording a critical survey of the methods of cotton cultivation practised in the United States, regarded from the standpoint of the spinner Moreover, the fundamental problems facing cotton-growers in all parts of the world are essentially similar—to obtain the greatest quantity of good-quality cotton at the lowest cost, to keep in check pests, and to market the product in the best condition

The lines along which these problems have been, or are being, solved in the country which at present produces some three-quarters of the world's total commercial cotton crop are of the greatest practical interest in all cotton-producing countries, actual or potential, because the average price at which American cotton can be placed on the market is the ultimate standard of comparison for their own efforts

It is clear, in the first place, that the United States suffer no restrictions from want of suitable land Texas alone is estimated to possess sufficient land to produce annually 30,000 000 bales[1] of cotton The average commercial crop of the world is now about 17,000,000 bales, to which the United States contribute 10,600,000, Texas producing about 3,000 000 bales Labour conditions in the cotton belt, as well as the recent movement in favour of "diversified farming," are opposed to great extension of the acreage under cotton, and a larger output would appear to depend on increased production per acre

SEED SELECTION —The first place in the practical methods proposed to attain this end is given to seed selection To those acquainted with the work of Dr Webber and other officers of the U S Department of Agrict [illegible] and the wonderful activity of the department [illegible] nating agricultural literature and advic [illegible] t surprising to find that "this is a po [illegible] ttle attention has been paid, no do [illegible] of knowledge," but, as is pointed [illegible] nnection, the small negro farmer still grow [illegible] portion of the crop, and "it is difficult adequ [illegible] to describe the slip-shod and primitive methods which he employs" It must be remembered, too that this report does not deal with "Sea Island" cotton, and that the careful work on seed selection which has made the cottons from Colonel Rivers's and other estates world famous is not under criticism

Seed selection conducted on trial plots in an experiment station or in a nursery with a trained staff is tedious and arduous enough, but the practical difficulties are increased a hundredfold on estates with labour of a low order of intelligence Other practical obstacles are also encountered The first picking is generally regarded as yielding the best seed, but frequently the farmer has mortgaged his crop and sold in advance both seed and lint of the first and second pickings, and uses seed from the third and worst picking from which to raise the next year's crop Advances have, however, been made, and two general principles are enunciated Where labour is abundant the aim should be to select plants maturing over a comparatively long period and giving a large number of pickings Where labour is scarce the selection should be of plants which ripen all their bolls as nearly as possible at the same time Two examples are quoted "Texas Oak" (said to give the greatest yield of upland cotton) gives 10 per cent of the total yield at the first picking and 40 per cent at each of the second and third pickings On the other hand, the variety "King" yields 40 per cent at the first and another 40 per cent at the second picking only a fortnight later

[1] The weight of a bale of cotton is taken throughout as 500 lb

FERTILISERS —In the eastern States (North and South Carolina, Georgia, and Alabama) of the cotton belt careful attention has been directed to the use of manures, encouraged, it is suggested, by the phosphatic deposits in the neighbourhood of Charleston Between 1879 and 1905 the average yield per acre in these States increased by 35 2 per cent, whilst in the western States the increase during the same period was only 4 2 per cent

CULTIVATION —The negro farmer appears to be largely responsible for the very slow progress effected in this direction Much land is still cultivated on the "share system," with all its consequent disadvantages Improvements in cultural implements have been very rare, and the great desideratum is still an efficient cotton-picking machine, this operation alone costing now about 2¼ cents per lb of lint—practically a quarter of the total cost of production

PESTS —The cotton boll weevil (*Anthonomus grandis*) is the most serious of all the American cotton pests It now infests about one-third of the cotton area, is advancing at the rate of fifty miles per annum, and reduces the crop to about one half in attacked areas The loss due to it in Texas alone in 1904 was estimated at 22 000,000 dollars Clean cultivation, the burning of old plants, and the establishment of early maturing and resistant varieties by seed selection work appear the most promising methods for dealing with this formidable pest

GINNING —The saw-gin, first invented by Whitney more than a century ago, still holds the field by virtue of its large output, although its defects are well recognised Interesting information is afforded on other types of gins, still more or less in the experimental stage

BALING —The bad qualities of the American cotton bale are notorious, and the commissioners quote as "none too severe" Judge Ogden's description of it at the Washington Conference of Spinners and Planters in May last as "a dirty, damaged, disreputable, water-soaked, wasteful, slovenly, clumsy, highly inflammable, turtle-backed package"

The American bale has a density of only 22 lb per cubic foot, as opposed to 37 lb and 56 lb for Egyptian and Indian bales respectively A bale with a density of about 40 lb per cubic foot is recommended, and other improvements advocated in regard to packing, &c, which, if carried out, would, it is estimated, result in a saving of about 1,000 000*l* annually, chiefly in cost of freight

The principal recommendations and criticisms contained in the report are worthy of serious consideration in all countries engaged in the cultivation of cotton An effort may soon be made to put them into practice in the United States, as owing to the action of the cotton growers' associations in attempting to control supplies, a proposal is under consideration for English spinners to establish plantations in the cotton belt, and a second commission has already left England to select a suitable scene of operations

NOTES

THE prevalence and treatment of insanity have been the subject of much consideration recently, but it appears from a letter by Prof Clifford Allbutt in Wednesday's *Times* that though our system of public asylums is honourable and humane in intention, it is in a scientific sense, a gigantic muddle In fact, our management of insanity is, scientifically, a chaos "Muddle! In England, and in England alone, we muddle with complacency Now to muddle is to labour with effects without regard to causes Thus it is that we strive with the 'unemployed', thus that we strive with commercial incapacity, thus that we strive with educational failures, and so forth, 'compromise' being with us not the word for adaptations but for supineness We pile up hospitals, sanatoriums, sick asylums, homes for incurables, colonies for epileptics and idiots, at vast cost direct and indirect, and wealthy persons make bequests, sometimes even liberal bequests, to such purposes; but what testator leaves money to an organisation of research by physicians and pathologists into the sources from which this frightful and manifold destruction pours forth with an absolutely, and perhaps with a relatively, augmenting volume? (I must not seem to forget the Lister Institute or recent gifts to the Cancer Fund, but of the general truth of my statement your own reports of bequests from day to day are sufficient testimony) No wonder that, thus ignorant but beginning to 'wake up,' we run to the nearest plausible short cuts—to quackery and to hand-to-mouth remedies which are no remedies—rather than to the laborious investigation of origins and accelerations If fifty years ago a tithe of the money expended upon the charities which are fighting at heavy odds with consequences had been spent upon knowledge, and this knowledge had been applied to prevention by a Ministry of Health instead of, as in its present imperfection, by a secondary department of some other office, by this time half of our expenditure on these melancholy results of our ignorance would have been saved, and the saving would be rapidly multiplying itself" Prof Allbutt urges that hospitals should be established for research into diseases of the nervous system certain wards or wings being provided for the insane The staff of a hospital of this kind should consist of young physicians intellectually mature and highly and variously trained Only when continuous and critical observations have been made under scientific conditions will it be possible to begin to create a classification of diseases of the nervous system by pathological affinity to displace the classifications which now are admirable only or chiefly for logical and metaphysical ingenuity

DR N L BRITTON, director of the New York Botanical Garden, has been elected president of the New York Academy of Sciences

A PAPER by the Duke of the Abruzzi upon his expedition to Mount Ruwenzori will be read at a special meeting of the Royal Geographical Society on Saturday, January 12

MR SYDNEY S HOUGH, F R S, chief assistant in the Royal Observatory, Cape of Good Hope has been appointed His Majesty's astronomer at that observatory on the retirement of Sir David Gill, K C B, F R S

THE honorary treasurer of the Imperial Cancer Research Fund has received from Mr and Mrs Bischoffsheim the munificent donation of 40,000*l* on the occasion of the celebration of their golden wedding

AT the annual banquet of the Institute of Chemistry of France a few days ago, it was announced in the name of the Minister of Public Instruction that the French Government has drawn up a decree giving academic recognition to the profession of chemical engineer

THE *Kew Bulletin* announces that Captain A T Gage has been appointed superintendent of the Royal Botanic Gardens, Calcutta, and director of the Botanical Survey of India We learn from the same source that Dr D H Scott, F R S, has relinquished his post of honorary director of the Jodrell Laboratory, Kew, which he has filled with great distinction during the past fourteen years

A MOVEMENT has been inaugurated by the professors of the National Museum of Natural History in Paris, with the approval of the Minister of Public Instruction for the erection of a statue of Lamarck in the Jardin des Plantes Subscriptions to the fund which is being raised may be sent to M Joubin, secretary to the committee, 55 rue de Buffon, Paris

THE Aëro Club has arranged for an exhibition in connection with the International Motor-car Exhibition to be held at the Royal Agricultural Hall, London from April 6–13 next Prizes to the value of 250*l* are offered by the proprietors of the *Daily Mail* for model flying machines, and full particulars as to the conditions of the competition may be obtained from Mr Harold E Perrin Aero Club, 166 Piccadilly, London, W

IT is stated in *Engineering* of December 28 1906, that the German Railway Union has presented to the Science Museum at Munich an exact reproduction of "Puffing Billy," the oldest locomotive in existence, now preserved in the Victoria and Albert Museum The Munich engine is an exact counterpart of the original, and has been tested under steam, when a train load of 38½ tons was hauled at upwards of six miles per hour The work was carried out at the central shops of the Royal Bavarian State Railways at Munich

WE learn from *Science* that Prof H F Osborn has declined the secretaryship of the Smithsonian Institution to which he was elected by the regents on December 4, 1906 In a letter to the Chancellor of the institution, Prof Osborn explains why he is unable to accept the post of secretary Chief among these reasons is the fact that he is nearing the completion of several monographs and books, the prosecution of which is dependent upon the collections which he has brought together in New York and the staff of trained assistants who are working with him

A SPECIAL report from Berlin in the *Pall Mall Gazette* of December 28 1906, described some wireless telephony experiments which have been made by Prof Slaby, who claims to have solved successfully the problem of wireless telephony which has been so often attempted The trials took place over a distance of forty kilometres between the headquarters of the Wireless Telegraph Co in Berlin and the wireless station at Nauen The microphone was connected to a wire rising about six metres above the roof, and both figures and a sentence of extreme phonetic difficulty were received and repeated back without error and very clearly heard Prof Slaby claims that no approach to forty kilometres has ever been tried before, and that his success is due to the isolation of the microphones and the "damping" of all foreign vibrations We do not know the greatest distance over which Mr Paulsen has successfully conducted his wireless telephony and we shall wait with interest to see what developments may

take place very shortly, as some marked advance may surely be expected when the results of the experiments of two such investigators as Prof. Slaby and Mr. Paulsen become fully known.

THE recent experience of the London County Council tramways under Arctic conditions has not strengthened the arguments of those sections of the public and engineers who are all for the abolition of the overhead system in favour of the underground conduit system. Granted that the conditions which caused the serious interruption of traffic last week are not usual and were not expected, it is still hard to account for the unpreparedness of those in charge of the London County Council tramways. In happy contrast to this comes the news of the capabilities of the overhead system in Liverpool, where not only was the service maintained without mishap, but the trams were of great assistance in clearing away the snow by drawing trollies of salt over the city, thus enabling the salt to be distributed rapidly, and making it easy work for the firemen to wash down the streets afterwards. Wolverhampton also suffered by not having an overhead system of tramways, and the service had to be discontinued. We have not yet heard of any case where an overhead system of tramways in England has failed owing to the recent snow, so that, at a time when the telegraph wires are being broken down by snow and by the force of the gales we have been experiencing lately, it speaks well for modern overhead tramway practice that it should have passed through the ordeal so successfully, and once again helps to prove that the supposed dangers and disadvantages of the overhead system are more fancied than real.

A CORRESPONDENT, writing from Torbay, states that on December 29, 1906 (full moon), and more particularly on December 30, from 10 p.m. to 11.30 p.m., she observed a remarkable lunar halo. The moon appeared in the centre of a pellucid patch of sky enclosed by the halo, which measured at least four times the moon's apparent diameter, and in this clear sky, as in a mirror, our correspondent saw a reflection of the moon.

WE learn from the *Pioneer Mail* that the Dooars' Planters' Association recently discussed the subject of malaria and black-water fever. The meeting viewed with great concern the alarming prevalence of malaria and black water fever in the western Dooars, and was of opinion that all possible steps should be taken to inquire into these diseases with a view to check them. The association is convinced that the report of the commission on malaria to the Royal Society dated 1902 goes to the root of the evil, and that the Anopheles mosquito, which is found in large numbers in the Dooars, is the cause of the prevalence of malaria and black water fever, and that no time should be lost before tackling the question scientifically. As a preliminary, the Indian Tea Association of Calcutta and London is to be asked to move in the matter, and the association will also address the local Government and the Government of India on the subject, and the Home Government through the Tea Association.

THE most important item in the November (1906) issue of the *Victorian Naturalist* is a paper by Prof. Baldwin Spencer on emu remains from King Island, Bass Strait. Definite information as to the former existence of an emu on this island is to hand, and since the bones recently discovered indicate a bird of smaller size than *Dromaeus ater* of Kangaroo Island, the name *D. minor* is proposed for the new species.

WE have to acknowledge the receipt of a copy of part ii (vol. i.) of the new journal *Experimentelle Beiträge zur Morphologie*, published at Leipzig, and edited by Mr. Hermann Braus, of Heidelberg. In the first article Mr. O. Bender describes a case of "hypermelism" in an edible frog, in which the abnormality takes the form of an additional hind limb, and discusses the morphological conclusions to be drawn therefrom. The second article, by the editor, is devoted to the mode of development of the fore-limb and operculum in the larva of the fire-bellied toad (Bombinator).

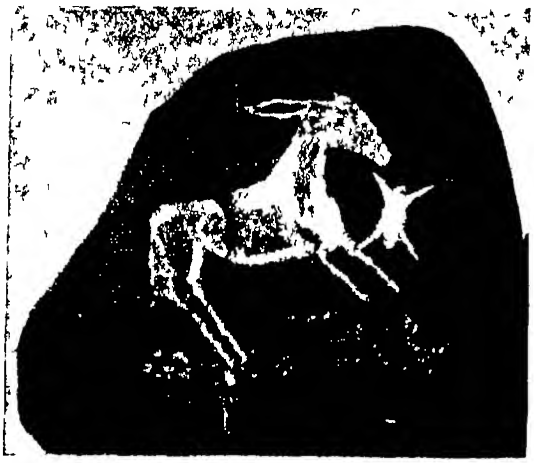
"SOME Problems of the Sea" forms the title of the presidential address delivered by Prof. Herdman to the meeting of the Liverpool Biological Society held on October 26, 1906. After alluding to the frequent periodical local variation in the constituents of the plankton and the endeavours which have been made to ascertain the actual or relative numbers of organisms inhabiting a given area in the sea, the president proceeded to institute a comparison between the littoral fauna of Ceylon and that of the Maldive Archipelago. In explanation of certain differences of these two faunas, it is suggested that it may be easier for a shallow-water, non-pelagic species to reach Australia from India by way of Malaysia rather than cross the open sea separating Ceylon from the Maldives.

THE first part of the sixth volume of *Annotationes Zoologicae Japonenses* opens with an account of a new Japanese salpeid provisionally referred to the genus Cyclosalpa, by Mr. W. E. Ritter. Although only a single specimen, taken in Suraga Bay, is forthcoming, this is amply sufficient to demonstrate the marked distinctness of the new form. Until examples of the aggregate generation are available, the full affinities of the species cannot be determined. Its most obvious features are the straight intestine, the great number of the muscle-bands, which exceed those of all other forms except one Salpa, and the fact that many of these bands extend right round the body. In the latter respect the new form tends to minimise the differences separating the Doliolidæ from the Salpidæ. The other papers in the same issue deal respectively with Japanese butterflies, cockroaches, and ascidians.

SINCE very little is known in regard to the segmentation of the ovum among mammals, workers in embryology should welcome a paper by Mr. M. Kunsemuller in the *Zeitschrift fur wissenschaftliche Zoologie*, vol. lxxxv., part 1, on this stage of development in the hedgehog. Comparisons are made between the segmentation in this species and other mammals in which it has been observed. A second article in the same issue deals with the early stages in the development of the grass-snake, from the first appearance of the pro-amnion to the close of the amniotic stage. The paper ends with a *résumé* of the present state of our knowledge of snake-development, which is still very imperfect. Regeneration in polychæte worms forms the subject of the third article, by Mr. P. Ivanoff, of St. Petersburg. Apparently the article was written previous to the issue of Nusbaum's paper on regeneration in Nereis in vol. lxxix. of the same journal, but its publication was delayed by the necessity of translation. Some of the author's conclusions have thus been anticipated. Among other curious examples of regeneration, Mr. Ivanoff mentions one case in which an annelid developed a complete functional head at each extremity of the body. In the fourth article Mr. F. Vejdovsky resumes his discussion of the hæmacœle theory as illustrated by the vascular system of worms.

WITH regard to the naming of plants of Lessonia received from the Antarctic region, Mr. and Mrs. A. Gepp note in the *Journal of Botany* (December, 1906) that anatomical investigation discloses a distinction between the specimens from Cape Adare and Coulman Island and that from the South Orkneys. The former receives the name of *Lessonia grandifolia*, the latter *L. simulans*.

IN vol. xvi. of the Transactions of the South African Philosophical Society is a paper by Mr. L. Péringuey on petroglyphs of animals and men in South Africa considered in relation to those found in northern Africa. He points out that two kinds of workmanship are found in Algeria and the Sudan—line engraving and dot engraving, the former being apparently much older, as prehistoric animals now extinct, such as *Bubalus antiquus*, are represented with great fidelity. Similar differences of technique exist in South Africa, and the author argues that they afford evidence of a pre-Bushman race akin to the aborigines of the north, but he is evidently a zoologist, not an anthropologist, and it is clear that more material is needed for comparison, as well as definite archæological data, before the views set forth in this paper can rank as



Rock engraving (chalked to show clearly) of a Gemsbok checking itself while at full speed.

more than mere conjectures. The article is well illustrated by ten figures, of which one is reproduced here; the author remarks that it represents a gemsbok checking itself at full speed before an object intended to alarm it, but it does not seem necessary to assume more than a chance connection between the figures. The petroglyphs were chalked over for photographic purposes; this introduces an element of uncertainty which it would be well to eliminate.

ON the subject of diseases of palms Mr. E. J. Butler contributes a paper to the *Agricultural Journal of India* (vol. i., part iv.) recording three diseases that have come under his observation in India. In the first case the inflorescences of betel-nut palms were destroyed by a Phytophthora causing what is locally known as "kale roga," or black rot; in another a bud-rot disease of palmyra and cocoa-nut palms in the Godavari district was traced to a Pythium. The so-called betel-nut plague occurring in Sylhet was more difficult to diagnose, but the author refers it definitely to a fungus attacking the roots, and the clamp connections in the mycelium point to its being a basidiomycete. Detailed descriptions are given and remedial measures suggested.

THE latest addition to the series of German pamphlets on the pedagogics of the natural sciences published by B. G. Teubner of Leipzig, deals with the subject of a scheme for teaching nature-study in schools. The author, Dr. P. Henkler, reviews several schemes advocated by masters of pedagogy and instructors in natural history before elaborating his own syllabus. During the first stage for small children, extending over three courses, it is suggested that interest in natural objects should be aroused by imaginative or personified presentment, and observation be coordinated with facts of everyday life. In the second stage botany and zoology would be taught as independent subjects, the essential idea being to stimulate the faculty of inquiry by studying purpose and cause.

MR. MALCOLM BURR has written for the Kent Coal Concessions, Ltd., a popular introduction to the study of the geology of the south-eastern coalfield. It contains in simple language a concise explanation of the principles of geology sufficient to enable shareholders to follow intelligently the significance of the various borings carried out under the auspices of the company.

IN the *Engineering Magazine* (vol. xxxii., No. 3) there is an admirably illustrated article by Mr. Frank L. Hess on the York tin region of Alaska, where lode tin was discovered in 1903. Should the lode deposits be shown to contain sufficient tin to pay for working, they will have many advantages over placer deposits, inasmuch as mining would not have to be confined to the short open season.

THE Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. l., part ii.) contains an interesting paper by Mr. Hugh Campbell on suction gas engines. The introduction of the suction gas plant invented in 1894 is causing a greater revolution in practice than has occurred in connection with the development of large gas engines which are mainly used at the present time in conjunction with blast-furnace gas. Its very high economy, extreme simplicity, its cleanliness, and the small amount of space it occupies are sufficient to commend it to power users.

A PAPER read by Mr. Henry Fowler before the Institution of Mechanical Engineers on December 14, 1906, dealing with the lighting of railway premises, contained much information of value to engineers generally. The lighting on a railway is chiefly provided by means of oil, gas, or electricity, gas being probably the most general illuminant. In most places it has been able to hold its position owing to the introduction of incandescent mantles. The cost of maintaining an incandescent mantle for a year to June, 1906, is shown to have been as follows:—mantles 5.20*d.*, chimneys 1.27*d.*, forks 0.33*d.*, and wages 1*s.* 4.16*d.* per annum.

IN a recent note (p. 181) attention was directed to the recent renewal of experiments with Count Zeppelin's latest airship on the Lake of Constance. An account of these new experiments is given by Dr. Wilhelm Krebs in *Das Weltall* for December 15, 1906. The 1906 Zeppelin airship, like its forerunners, consists of eighteen separate compartments or separate balloons supported on a rigid cylindrical aluminium framework, the whole being enclosed in a covering of balloon silk. The rigidity being secured by the framework, the use of an internal "ballonet" is dispensed with. The whole airship is 128 metres long by 11 metres high, and each of the two cars can hold four persons, besides having a separate motor. The author states that with both motors working simultaneously a

speed of 15 metres per second, or 54 kilometres per hour, can be maintained for sixty hours with the quantity of benzene the machine will carry With one motor alone working a speed of 11 metres per second would be maintained for 120 hours The advantages of the Zeppelin airship are more or less counterbalanced by the present necessity of using a sheet of water for starting and landing Apart from the uses of such a machine in warfare, its applications in time of peace to the meteorological survey of the atmosphere are contemplated

AN interesting but highly mathematical memoir by Prof Karl Pearson and Mr J Blakeman on "A Mathematical Theory of Random Migration" has just been issued by Messrs Dulau and Co (Drapers' Co research memoirs, biometric series, iii) The problem dealt with is, in simple terms, the following —given that a large number of individuals move by successive straight steps of length l in random directions, starting from one and the same point, required to find their distribution after n such steps The solution, which is obtained in terms of Bessel functions, is applicable to such practical problems as the infiltration of mosquitoes into a cleared area, or the recovery of a habitat by a species which has been driven out owing to temporarily unfavourable conditions Prof Pearson obtained some assistance in the solution of the problem through a letter addressed to our correspondence columns (vol lxxii p 294, July 27, 1905), Lord Rayleigh directed his attention (*ibid*, p 318) to the fact that when the number of steps n is very large, the problem becomes identical with a problem in sound, and Prof Kluyver presented a memoir on the subject to the Royal Academy of Sciences of Amsterdam (Proceedings, October 25, 1905) Reference should, we think, have been made, in the introduction to the memoir, to the address delivered by Major Ross "On the Logical Basis of the Sanitary Policy of Mosquito Reduction" at the St Louis Congress of 1904 (*British Medical Journal*, May 13 1905) This contains the first published discussion of the problem, with especial reference to its most important practical application and suggests a simple approximate solution in terms of the binomial series

AN investigation of the temperatures obtainable by the use of solid carbon dioxide under different pressures forms the subject of a paper by Messrs John Zeleny and Anthony Zeleny in the *Physical Review* (vol xxiii, No 4) In a deep vessel of such a shape that the material is surrounded by its own vapour, the same temperature is given under any one pressure by the carbon dioxide either alone or when mixed with alcohol or ether, it is, however, more easy to maintain the temperature constant when the solid is moistened with ether A table is given showing the temperatures obtainable by varying the pressure above the solid from 2 cm to 84 cm of mercury At the former pressure the temperature is $-116°7$, and at the latter $-77°$ C

SOME very remarkable results have been obtained by Prof R W Wood in the course of an investigation of the fluorescence and magnetic rotation spectra of sodium vapour, published in the Proceedings of the American Academy of Arts and Sciences (vol xlii, No 13), and also in the *Physikalische Zeitschrift* (No 24) The fluorescence spectra were observed using monochromatic light of a definite wave-length as source of excitation Different series of lines are seen with different exciting wave-lengths The series are mostly of a very simple character, consisting of groups of lines separated by a constant wave-length The same series of lines are also observed in the magnetic rotation spectrum of sodium vapour, which can thus be subjected to analysis Certain lines, however, which occur singly in the magnetic spectrum occur as doublets in the fluorescence spectra The detailed measurements obtained, from the comparative simplicity of the phenomena, are likely to prove of very great importance in discussing the mechanism of molecular vibration and radiation

FROM the dissociation theory of solution it might be inferred that as the radiation from a radio-active substance renders a gas conducting by causing ionisation of the gaseous particles, an increase of the conductivity of aqueous solutions should follow from their exposure to radio-active influence The effect in the latter case should, indeed, be very marked inasmuch as partial ionisation of a salt occurs merely on dissolving it in water, whereas in the case of a gas ionisation takes place only under special influences The conductivity of a large number of salts in aqueous solution has been measured by M S M Sabat (Bulletin of the Cracow Academy of Sciences, 1906, No 1) during their exposure to the radiation produced by 0 2 gram of Prof Curie's most active preparation of radium bromide After making allowance for the alteration of resistance caused by the rise of temperature due to the radiation, the conclusion is drawn that not the slightest change in conductivity can be attributed to a change in the degree of ionisation of the salt within the solution If such a change of ionisation takes place it is so slight as to be altogether negligible

MR DAVID NUTT has published for the Folk-lore Society a "Bibliography of Folk-lore" for 1905, which has been compiled by Mr N W Thomas The price of the booklet is 1s net

MESSRS J AND A CHURCHILL have published a third edition of "A Handbook of Physics and Chemistry adapted to the Requirements of the First Examination of the Conjoint Examining Board of the Royal Colleges of Physicians and Surgeons and also for General Use" by Messrs Herbert E Corbin and Archibald M Stewart

WE have received a copy of the report of the Meteorological Service of Canada for the year ended on December 31, 1904 In nearly four hundred foolscap pages Mr R F Stupart, the director, has brought together results of observations of the temperature, pressure, rainfall, snowfall, amount of bright sunshine, and other meteorological data concerning all parts of Canada The volume also includes the magnetic results for each month and for the year 1904

IN his work "Erkenntniss und Irrtum," reviewed in NATURE of November 30, 1905 (vol lxxiii, Supp, p vii) Prof E Mach partly included three essays in which the questions of the nature, origin, and development of our concepts of space were discussed from several points of view The English rendering of these essays, which originally appeared in the *Monist*, has now been published in volume form by Messrs Kegan Paul and Co, Ltd, under the title "Space and Geometry in the Light of Physiological, Psychological, and Physical Inquiry"

IN NATURE of October 11, 1906 (vol lxxiv, p 594), reference was made to a paper by Prof Kamerlingh Onnes and Dr Heuse on the expansion of glass at very low temperatures, and attention was directed to the work of Dr Travers on the same subject Prof Onnes writes to point out that the memoir referred to was a translation of a Dutch paper, published somewhat earlier than that of Dr Travers, to which we alluded, and that in a more recent communication on the same subject he has not failed to recognise the results obtained by this investigator

OUR ASTRONOMICAL COLUMN

COMET 1906g (THIELE).—From observations made with the Lick Observatory 12-inch refractor, Messrs. Aitken and Fath have computed a set of parabolic elements for Thiele's comet. These elements, together with an ephemeris extending to January 19, appear in No. 103 of the Lick Observatory Bulletins, and give the time of perihelion passage as 1906 November 21. The comet is at present (January 3) about 5 m. east of ι Draconis, and is travelling nearly due east, its brightness being about one-half that at the time of discovery (mag. 8·5).

THE LUNAR CRATER LINNÉ.—In a recent number of the *Astronomische Nachrichten* Dr. Wirtz pointed out that an apparent enlargement of the white spot surrounding Linné could be produced by interposing a shade-glass between the telescope and the eye, and from this fact he argued that the enlargement of the spot observed during a lunar eclipse might be merely a subjective phenomenon due to the diminution of light.

In No. 4141 of the same journal Prof. W. H. Pickering points out that whilst this apparent enlargement, which Dr. Wirtz describes, undoubtedly exists, its magnitude is much less than that recorded by the eclipse observers. Furthermore, the majority of the eclipse observations indicate that the white spot was decidedly larger after the passing than at the same length of time before the encroachment of the earth's shadow, whereas if the enlargement were merely a subjective effect it should not survive the re-illumination. The fact that Dr. Wirtz has observed similar results in the case of the crater Linné B is not regarded by Prof. Pickering as an argument against their reality, for if the phenomenon is due to the deposition of hoar-frost it should, *ceteris paribus*, be general over the moon's visible surface, and he has himself obtained similar results for Sulpicius Gallus A (*Astronomische Nachrichten*, No. 4141).

EPHEMERIDES OF COMETS AND PLANETS.—With the commencement of the new year the editors of the *Astronomische Nachrichten* are issuing the ephemerides of comets and planets in a separate publication called the *Ephemeriden-Zirkular der Astronomischen Nachrichten*. The annual subscription is 10 marks, and orders should be addressed directly to the "Expedition in Kiel, Niemannsweg 103."

A RÉSUMÉ OF AREOGRAPHY.—In No. 22 (1906) of the *Revue générale des Sciences*, L'Abbé Th. Moreux discusses the present state of our knowledge of Mars especially in reference to the more recent observations of Prof. Lowell and other aerographers, although in the first part he details the work of the earlier observers, Herschel, Beer and Madler, Secchi, Lockyer, Kaiser, and others. Whilst agreeing with Lowell as to the bolder features, M. Moreux evidently entertains very grave doubts as to the objective reality of many of the fine rectilinear *canaux* of which the former observer has recorded 420, and further states that he has never seen the alleged *oases* which are said to mark their intersections.

M. Moreux also discusses the gemination of the canals at some length, and then gives in detail the results of his own observations during the opposition of 1905, giving a number of drawings and a chart to illustrate his points. From these observations he is convinced that the persistent transparency of the Martian atmosphere has been overrated in the past. To illustrate this conviction he gives instances of cloud formations blotting out the detail locally, on the planet's surface.

JUPITER'S SATELLITES.—No. 4143 of the *Astronomische Nachrichten* contains an ephemeris for Jupiter's sixth satellite, computed by Mr. J. F. Martin, of Washington, from unpublished elements derived by Dr. Ross. The ephemeris extends to April 17, 1907, and gives the differences (Satellite–Jupiter) in α and δ, and the position angle and distance from the planet for every fifth day.

In the same journal Herr K. Graff records the observation, on September 24, 1906, of the occultation of an 8·5 magnitude star by Jupiter's third satellite.

THE CAUSES OF SOLAR PHENOMENA.—We have received from Don Horacio Bentabol y Ureta, of Madrid, a monograph dealing with the causes which produce spots, prominences, faculæ, &c., on the sun. The discussion is too lengthy to give the author's points *in extenso*, but he favours the meteoritic origin of the spots, and shows how the other solar, and the correlated meteorological, phenomena may be accounted for on this hypothesis.

PRIZES AWARDED AND PROPOSED BY THE PARIS ACADEMY OF SCIENCES.

AT the anniversary meeting of the Paris Academy of Sciences held on December 17, 1906, the president, M. H. Poincaré, announced that the prize awards for the year 1906 were as follows:—

PRIZES AWARDED.

Mathematics.—Grand prize in the mathematical sciences, divided between H. Padé (1500 francs), R. de Montessus (1000 francs), and M. Auric (500 francs), for their work on the convergence of continued algebraical fractions. The Francœur prize to Émile Lemoine, for his works on geometry. The Poncelet prize to M. Guichard, for the whole of his contributions to geometry.

Mechanics.—A Montyon prize to Georges Marié, for his study of the oscillations of railway carriages; the Boileau prize to Edmond Maillet, for his investigations on the yield of deep springs.

Navigation.—The extraordinary prize of 6000 francs, divided between MM. Daveluy, Rollet de l'Isle, J. Th. Saconney, and G. B. Girard; the Plumey prize to Prof. Stodola, for his work on steam turbines.

Astronomy.—The Pierre Guzman prize was not awarded. The Lalande prize to R. G. Aitken and W. J. Hussey, for their work on double stars; the Valz prize to J. Palisa, for the whole of his astronomical researches; the Janssen medal to A. Riccò, for his observations on the sun.

Geography.—The Tchihatchef prize to Jean Baptiste Louis Pierre; the Binoux prize to MM. Larras and F. de Larminat; the Delalande prize to L. Seurat, for his exploration of the islands near Tahiti.

Physics.—The Hebert prize to G. Gouré de Villemontée, for his researches on the conditions governing differences of contact potential; the Hughes prize to Daniel Berthelot, for his application of interference methods to the measurement of high temperatures and his researches on the compressibility of gases.

Chemistry.—The Jecker prize to M. Grignard, for his researches on the organo-magnesium compounds; the Cahours prize to M. Martine, for his work on menthone and menthol and their derivatives; a Montyon prize (unhealthy trades) to Victor Georgel, for his researches on leadless glazes.

Botany.—The Desmazières prize to Jules Cardot, for his researches on mosses; the Montagne prize to Émile Boudier, for his work on mycology; the De Coincy prize to E. G. Camus and Mlle. A. Camus, for their work on the classification and monography of the willows of Europe.

Anatomy and Zoology.—The Savigny prize to Paul Pallary, for his work on northern Africa and the Red Sea; the Thore prize to C. Houlbert, for his entomological work; the Gama Machado prize to Antoine Henri Mandoul and Pierre Stéphan (in equal parts).

Medicine and Surgery.—Montyon prizes to Paul Poirier and A. Charpy, for their work on anatomy; J. Albarran, for his work on renal functions; and Ch. Porcher, for his studies on lactosuria. Mentions are also accorded to Robert Lœwy, for his memoir on fractures; to Adolphe Javal, for his memoir on the treatment of Bright's œdema; and to MM. Guillemard and Moog, for their work on the influence of high altitudes on the general nutrition. Citations are accorded to Lucien Graux, Louis and Paul Murat, and A. Gougenheim. The Barbier prize to Adrien Lucet, for his memoirs on the bacteriology of suppuration in animals of the bovine species and on pathogenic moulds, with a mention to J. V. Detroye, for his work on cancers and tumours in animals. The Bréant prize to M. Rémy, for his quantitative studies on serums; the Godard prize to L. H. Farabeuf, for his monograph on the blood vessels of the genito-urinary organs; the Baron Larrey prize to Dr. Morel, for his memoir on epidemic and endemic diseases in the French colonies; the Bellion prize to Georges G.

Paraf, for his work on hygiene; the Mège prize to S. Turchini, for his experimental study on the power of the X-ray tube under different conditions of use.

Physiology.—A Montyon prize to E. Meyer, for his researches in experimental physiology from 1886 to 1904, a mention being accorded to J. Sellier for his researches on digestion and the digestive ferments; the Philipeaux prize to Stéphane Leduc, for the whole of his researches in experimental physiology, M. Caubert receiving a mention; the Lallemand prize to André Léri, for his clinical and anatomical researches on tabes; the Pourat prize to Georges Bohn, for his researches on phototropism; the Martin-Damourette prize to Lucien Butte, for his researches on the physiological and therapeutical action of Guaco (*Aristolochia cymbifera*), a very honourable mention being accorded to Pierre Sée for his study of the therapeutical applications of the oxydases and the metal ferments.

Statistics.—A Montyon prize to Dr. Ausset, for his memoir on the infantile mortality in the Département du Nord, a very honourable mention being accorded to Dr. Butte for his memoir on the statistics of syphilis in Paris, and an honourable mention to Dr. Ott for his work on infant mortality in the town of Lillebonne.

General Prizes.—The Lavoisier medal to S. M. Jorgensen, for his researches in inorganic chemistry; the Berthelot medal to S. M. Jorgensen and M. Martine; the Trémont prize to M. Frémont, for his experimental researches on metals; the Gegner prize to J. H. Fabre; the Lannelongue prize divided between Mme. Beclard and Mme. Cusco; the Jerome Ponti prize divided between M. Offret, for his work in mineralogy, and M. Gruvel, for his researches on the Cirrhipedæ; the Wilde prize divided between M. Termier, for his researches on the geological structure of the eastern Alps, and M. Massau, for his work in applied mechanics, and especially for his researches in graphical integration; the Saintour prize divided between Ant. Magnin, for his work in botanical geography, and I. Laurent, for his work in plant palæontology; the Houllevigue prize divided between G. André, for his researches in the physiological chemistry of plants, E. Bataillon, for the whole of his researches in experimental embryology, and A. Pizon, for his work on the development of the tunicates; the Cuvier prize to Dr. Raffray, for the whole of his work on insects; the Jean Reynaud prize to Pierre Curie, for his work on piezoelectricity and the properties of the radio-active bodies; the Baron de Joest prize to M. Demoulin, for his researches in infinitesimal geometry; the prize founded by the Marquise de Laplace to Paul Pierre Lévy; and the prize founded by M. Félix Rivot to MM. Lévy, Bélugou, Petit, and Lane.

PRIZES PROPOSED.

The subjects proposed by the academy for prizes for 1908 are as follows:—

Geometry.—The grand prize of the mathematical sciences (3000 francs). The question proposed for 1908 is the following:—to realise an important progress in the study of the deformation of the general surface of the second degree; the Francœur prize (1000 francs), for discoveries or work useful to the progress of the sciences of pure and applied mathematics.

Mechanics.—A Montyon prize (700 francs), for the invention or improvement of instruments useful to the progress of agriculture, the mechanical arts, or sciences; the Fourneyron prize (1000 francs), for a theoretical or experimental study of steam turbines.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficacy of the French naval forces; the Plumey prize (4000 francs), for improvements in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—The Lalande prize (540 francs), for an observation, memoir, or work most useful to the progress of astronomy; the Valz prize (460 francs), to the author of the most interesting astronomical observation made during the year; the Damoiseau prize (2000 francs), the question proposed is the theory of the planet Eros based upon known observations; the Janssen prize (a gold medal), for a discovery or work constituting an important progress in physical astronomy.

Geography.—The Gay prize (1500 francs), for geographical studies on Morocco; the Tchihatchef prize (3000 francs), for the exploration of the lesser-known regions of Asia, the work being done in any branch of science; the Binoux prize (2000 francs), for work in geography and navigation; the Delalande-Guérineau prize (1000 francs).

Physics.—The Hébert prize (1000 francs), for the best treatise or most useful discovery for the practical employment of electricity; the Hughes prize (2500 francs), for discoveries or works contributing to the progress of physics.

Chemistry.—The Jecker prize (10,000 francs), for work in organic chemistry; the Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prize (a prize of 2500 francs and a mention of 1500 francs), for a discovery of a means of rendering an art or trade less unhealthy.

Mineralogy and Geology.—The Fontannes prize (2000 francs), for the best palæontological publication; the Bordin prize (3000 francs), for a study of the fossil fishes of the Paris basin.

Botany.—The Desmazières prize (1600 francs), for the best work during the current year on cryptogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development, or description of the lower cryptogams; the de Coincy prize (900 francs), for a work on phanerogams.

Anatomy and Zoology.—The Savigny prize (1300 francs), for assisting young travelling zoologists, with special reference to the invertebrate animals of Egypt and Syria; the Thore prize (200 francs), for the best work on the habits and anatomy of a species of European insect.

Medicine and Surgery.—A Montyon prize (prize of 2500 francs, mentions of 1500 francs), for work or discoveries useful in the art of healing; the Barbier prize (2000 francs), for a discovery in the surgical, medical, or pharmaceutical sciences, or in botany with reference to the art of healing; the Bréant prize (100,000 francs), for the discovery of a drug which will cure Asiatic cholera in the great majority of cases, or for indicating in an absolutely certain manner the causes of Asiatic cholera, so that by the suppression of these causes the epidemic can be stopped, or, in the alternative, for the discovery of a prophylactic treatment as certain as that of vaccination for small-pox. If the capital sum is not awarded, the interest will be given as a prize for a rigorous demonstration of the existence in the atmosphere of material taking part in the production or propagation of epidemic diseases. The Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; the Baron Larrey prize (750 francs), for a work by an army or navy surgeon or physician treating of the subject of military medicine, surgery, or hygiene; the Bellion prize (1400 francs), for the author of works or discoveries "especially profitable to the health of man or the amelioration of the human species"; the Mège prize (10,000 francs); the Serres prize (7500 francs), for the best work dealing with general embryology applied as far as possible to physiology and medicine.

Physiology.—A Montyon prize (750 francs), for a work on experimental physiology; the Philipeaux prize (900 francs), for the same; the Lallemand prize (1800 francs), to recompense or encourage works relating to the nervous system; the Martin-Damourette prize (1400 francs), for work in therapeutical physiology; the Pourat prize (1000 francs), for a work on the immediate destination of the energy devoted to maintaining life in warm-blooded subjects.

Statistics.—A Montyon prize of 1000 francs and a mention of 500 francs.

General Prizes.—The Arago medal; the Lavoisier medal for services to chemistry; the Berthelot medal; the Trémont prize (1100 francs); the Gegner prize (3800 francs); the Lannelongue prize (2000 francs); the Wilde prize (one of 4000 francs or two of 2000 francs); the Victor Raulin prize (1500 francs); the Saintour prize (3000 francs); the prize founded by Mme. la Marquise de Laplace; the Félix Rivot prize (2500 francs); the Jerome Ponti prize (3500 francs); the Houllevigue prize (5000 francs); the Estrade-Delcros prize (8000 francs).

Of these prizes, those bearing the names of Lalande, Tchihatchef, Desmazières, Lavoisier, and Wilde are expressly stated to be free from any restriction as to nationality.

RECENT WORK OF THE AMERICAN BUREAU OF STANDARDS

PART 1 of vol II of the Bulletin of the Bureau of Standards of the United States contains five papers The first of these is by Mr Hyde, on Talbot's law as applied to the rotating sectored disc The law is stated by Helmholtz as follows —" If any part of the retina is excited with intermittent light recurring periodically and regularly in the same way, and if the period is sufficiently short, a continuous impression will result, which is the same as that which would result if the total light received during each period were uniformly distributed throughout the whole period "

Much experimental work has been done on the subject leading to somewhat conflicting results. After a theoretical discussion Mr Hyde describes his own experiments, from which he concludes —

(1) Talbot's law is verified for white light for all total angular openings from 10° to 288° to within a possible error of 0 3 per cent

(2) The observed deviations from the law for red, green, and blue light are of the same order as those for white light

The two papers by Dr Guthe and Mr Rosa respectively deal with a new determination of the E M F of the Weston and Clark cells by a Gray electrodynamometer The construction of the instrument and the measurement of its exact dimensions are described in great detail by Dr Guthe in the first paper, while in the second Mr Rosa gives the complete theory of the dynamometer employed and discusses the effects of various errors, such as inaccuracy in the measurement of the dimensions of the coils, irregularities in their winding, and the effect of the opening in the fixed coil through which the suspension of the movable coil passes The chief results of the work are as follows —

The E M F of Guthe's "reference standard " cadmium cell, No 813, at 21° C = 1 01884 volts, or only two parts in 100,000 higher than the value given in its Reichsanstalt certificate The electrochemical equivalent of silver, determined by Guthe in 1904 (Bull Bur Stand , vol I part 1) in terms of a Weston cell, becomes, when recalculated to absolute measure, 1 11773 mg per coulomb, when the porous-pot form of coulometer is used

In the next paper Prof J G Coffin discusses the construction and calculation of inductance standards for Clark University and for the Bureau of Standards The paper gives in great detail an account of the successive operations One of the most interesting of these is the use for the accurate grinding of the marble cylinders of an especially fine grinding-machine on a novel principle, which will grind if required true cylinders up to 71 cm diameter, more than 3 metres long, and up to ten tons in weight The construction and winding of the cylinders presented many of the same problems as the making of the coils of the electrodynamometer referred to above, the coils in both cases being formed of a single layer of wire divided into several parts highly insulated from one another Following the practical details comes a long mathematical discussion setting forth the methods employed for calculation to the high accuracy required of the inductances of the various parts the two different formulæ employed giving, for the calculated self-inductance of one of the sections of the Clark University coil, values only differing by one part in four hundred thousand

The last paper by Messrs Hyde and Brooks, is on an efficiency meter for electric incandescent lamps It consists of an attachment to a photometer on which a scale of watts-per-candle can be arranged so that the "efficiency" of the lamp to be tested can be directly read off in a very simple manner without calculation The essential feature consists in the right design to give the desired result of a rheostat in the lamp-circuit, operated by the sliding of one of the photometer carriages A table of results shows that for a nominal sixteen candle-power lamp over a range of from ten to twenty candles with accompanying variation of watts per-candle of from 4 8 to 2 4, the value for the efficiency as obtained by the instrument and that determined independently by check instruments agreed everywhere to less than 1 per cent The value of the arrangement lies in the extreme rapidity with which a definite criterion for a large number of specimen lamps can be obtained without troublesome arithmetic

In part ii of vol II the first paper, by Mr Rosa, deals with the calculation of the inductance of single-layer coils The different types of " summation " and " current sheet " formulæ due to Rayleigh, Coffin, and Lorenz, and their suitability for use with coils of different shapes, are discussed at length Examples are also given showing the degree of concordance obtained in definite cases Tables of general application are calculated, from which the correction term for coils of varying number of turns, made of wire of different diameters, may readily be obtained

The paper by Mr H C Dickinson is entitled " Heat Treatment of High-temperature Mercurial Thermometers " It begins by recapitulating the methods of construction of high-range thermometers and the properties and suitability for different ranges of the various high-temperature glasses employed Tables of the departure of the natural scale of 16^{III} and 59^{III} glasses from the gas scale are given up to temperatures of 300° C and 500° C respectively The author then describes his own experiments, which deal chiefly with the effect of initial heat treatment on various unannealed thermometers of the different glasses specially constructed for research purposes The best methods of annealing such thermometers for rendering them as permanent as possible in after use are described An electric furnace arranged for the purpose is also shown The following are the more important conclusions of the paper —

(1) Jena 59^{III} borosilicate is the best thermometric glass in use for high temperatures, but it cannot be safely used much above 500° C

(2) Jena 16^{III} glass can be used up to 450° C

(3) Every thermometer intended for use above 100° C should undergo a suitable system of annealing before use The annealing may be done before the thermometer is filled A thorough anneal requires four to ten days at 450° C The anneal may be followed with advantage by a period of slow cooling of from three to six days

(4) To prevent the boiling of the mercury in a thermometer, the space above it should be filled with dry nitrogen or carbon dioxide having a pressure of one atmosphere at 300° C , of four and a half atmospheres at 450° C , and of twenty atmospheres at 550° C

Mr Brooks in his paper describes a new potentiometer for E M F and current measurements of intermediate accuracy It is primarily intended for use in such work as photometry, where rapidity of reading is essential, and where the best deflection instruments give an accuracy, insufficient in most cases

The feature of the new design is that the potentiometer method is used to balance the bulk of the electrical quantity to be measured, the remainder perhaps 1 per cent of the whole being shown by a suitable deflection instrument The design of a successful deflection potentiometer presents several difficulties In the present case these have been surmounted in a manner similar to that adopted by Stansfield, who was the first to use this type of instrument The greatest scale error in the new instrument described is 0 02 in 100 volts

In a paper on spectrum lines as light sources Mr Bates discusses the structure of the sodium D lines and the green mercury line $\lambda = 546 1$ $\mu\mu$ as sources in polariscopic measurements Sodium lines obtained in different ways show slight differences For intense illumination the author prefers sticks of pure Na_2CO_3 fed into an oxy hydrogen flame An echelon spectroscope was used for the study of the lines The position and intensity of the satellites of the green mercury line were accurately measured The use of this line is proposed as the standard source for all accurate polariscopic work A quartz rotation for wave-length 589 25 $\mu\mu$ may be obtained by measuring the rotation for the wave-length 546 1 $\mu\mu$, and multiplying it by the constant 0 850944

The paper by Mr Nutting, on polarimetric sensibility and accuracy hardly permits of useful abstraction It deals with the intensity and homogeneity of sources used in polarimetry The mathematical theory of the half-shadow polarimeter is discussed and formulæ given for calculating the sensibility of the instrument under varying

conditions A later paper by the same author describes a pocket spectrophotometer embodying some novel features

In the paper on the platinum-point electrolytic detector for electrical waves Mr Austin describes the so-called "barretter" patented by Fessenden, and used by him as detector in wireless telegraphy experiments It consists of a cell with electrodes, one a fine platinum point, the second a plate, the vessel being filled with an electrolyte giving gaseous decomposition products When an E M F is applied to such a cell polarisation ensues so that scarcely any current passes unless the E M F exceeds a certain critical value When electric oscillations pass through the cell the resistance is decreased, and the current for the moment increases Conflicting statements have been made by various investigators regarding the behaviour of the instrument, and the author has therefore subjected it to a thorough investigation, employing both ordinary alternating current waves and also the Hertzian waves from the station of the National Electric Signalling Company The chief conclusions of the research are —

(1) For the stronger alternating currents used the breaking down in resistance is approximately proportional to the square of the alternating current

(2) Under favourable conditions and with moderate polarisation the detector is equally sensitive to alternating currents with the point electrode, anode, or kathode

(3) The resistance of the detector for slowly alternating currents varied from 20,000 ohms to 400 ohms, according to the polarising E M F employed

(4) For electrical waves from a distance the detector is approximately equally sensitive with the point electrode, anode or kathode but for waves from a coil in the laboratory some cause appears to annul the sensitiveness of the kathode-point electrode

The next paper by Prof Coffin is a mathematical investigation on the influence of frequency on self-inductance, and is not capable of useful abstraction

Messrs Guthe and Austin then deal with experiments on the magnetic alloys discovered accidentally by Dr Heusler, and previously investigated at the Reichsanstalt and by Messrs Fleming and Hadfield Curves of permeability and inductance were determined for seven different samples the chemical analysis of which is also given An ingenious apparatus of high sensitiveness, quite cheap and easy to construct was designed for study of the magnetic expansion of the alloys This was capable of detecting changes in length as small as 5×10^{-7} mm The investigation is not complete but the relations between the curves of magnetisation and magnetostriction and between magnetostriction and thermoelectric force are clearly shown

The number and variety of the subjects dealt with in these two instalments of the official publication of the Bureau show that though only established three years ago it has already begun to make substantial additions to our knowledge of physics

J A HARKER

RESEARCHES IN STELLAR PARALLAX[1]

SOME years ago Dr Chase, of the Yale University Observatory communicated to the Astronomical and Astrophysical Society of America the results of a survey which he had carried out in collaboration with Dr Elkin in order to detect stellar parallax The number of stars examined was ninety two and these were generally selected from a list of stars having an annual proper motion of more than half a second of arc Of these ninety-two stars, fifteen had a negative parallax and, presuming that some of the smaller positive values were equally untrustworthy, some sixty were left which exhibited a real parallax amounting to more than 0″ 05 The scheme was one that seemed worthy of further prosecution, since the method employed proved adequate for the purpose of recognising the existence of measurable parallax Consequently, this work has been very considerably extended, and the recent publication from Yale gives the details of the discussion of no less than 163 stars, forming a contribution of the highest importance in parallactic inquiry Some thirteen years have been devoted to the completion of this work, in which, though Dr Elkin and Mr Smith have taken part, the heat and burden of the day has been borne by Dr Chase This will be seen from the following tabular statement, which shows both the class of stars examined and the distribution of the work among the several observers —

	Chase	Chase Elkin	Smith	Smith Elkin	Elkin
Stars with proper motion over 0″ 4	117	5	13	12	10
Stars selected by De Ball on account of magnitude	11	—	1	1	—
β Cygni, Algol, Nova Persei	5	—	—	—	—
Red stars for colour effect	6	—	—	—	—
Total number of series	139	5	14	13	10

The inquiry has been based entirely on measures of distance made with the heliometer As a rule, two comparison stars were selected on opposite sides of the star the distance of which was to be investigated, and in the direction of maximum displacement by parallax These comparison stars were as nearly as possible equidistant from the principal star When the arrangement of the stars did not permit this programme to be carried out completely special artifices had to be adopted On the other hand, in the case of stars of particular interest, a larger number of comparison stars was selected The precautions which Dr Elkin found necessary in the course of his work on the parallaxes of stars of the first magnitude were applied here, and further reference to these details is unnecessary Finally, the observations, when collected usually give for each star twelve complete observations, consisting of four groups of three nights each, taken at those seasons of the year when the parallactic displacement was at its maximum

A suspicion having been aroused that the measures of distance between two stars of different colours might need an additional correction for refraction a series of observations was made on some strongly coloured red stars taken from Kruger's "*Catalog der farbigen Sterne*" A term was introduced into the differential refraction correction of the form $\Delta\beta \tan z \cos(p-q)$ where p is the position, q the parallactic angle, z the zenith distance and $\Delta\beta$ the colour effect sought The several values of $\Delta\beta$ are as follows —

Star	Colour Scale	Δβ	Weight
Kruger 985	6 0	−0″ 019±0″ 019	63 6
,, 1080	7 0	+0 005±0 020	64 4
,, 1078	7 1	+0 009±0 015	16 0
,, 1181	7 8	+0 014±0 018	55 7
,, 1108	8 7	+0 046±0 017	45 2
W B XV, 745	—	0 003±0 021	55 6

The authors contend from these figures that the mean light of the red star is apparently refracted less than that of the comparison stars Whether this conclusion is justified or not, the quantities involved are so small that it can be safely asserted that there is no noticeable vitiation in the parallax results arising from this cause within the probable errors The remark attributed to Sir David Gill, that the tendency of the heliometer observer is to bring the similarly coloured parts of the star's spectra into coincidence rather than the brightest parts, seems to gain additional support from this investigation

Of the 163 stars examined the parallaxes range from −0″ 13 to +0″ 20, and the number of negative parallaxes is thirty-six Considering how wide the net has been spread to catch any star the proximity of which might be suspected on various grounds, the chance of finding stars closer to us than those which have already been examined grows very slight The scheme of the stellar universe so far as the few stars nearest to us are concerned, is taking fairly definite shape, and the scale that has been adopted from measured parallax will probably need no material alteration Such a conclusion is the more warranted, because the precision attaching to the mean value of a group of results is far greater than that of any individual determination The authors insist upon this point, and,

[1] "Parallax Investigations on 163 Stars mainly of large Proper Motion By Frederick L Chase, Mason F Smith and William L. Elkin Transactions of the Astronomical Observatory of Yale University, vol ii part i Pp 207 (New Haven The Observatory, 1906)

as a matter of fact, have grouped their results in various ways, all instructive. The average values obtained from these groups are of unquestionable significance

Seeing that the working catalogue was made to depend upon the amount of proper motion, it was most natural to arrange the final parallaxes in such a way as to show what relation existed between these quantities The following table makes this clear —

Range of Proper Motion	No. of Stars	Average Magnitude	Average Proper Motion	Average Parallax
" "			"	"
0 0 to 0 34	21	3 8	0 14	+0 019
0 41 to 0 54	39	6 3	0 49	+0 032
0 55 to 0 65	45	6 7	0 59	+0 059
0 66 to 0 96	46	6 5	0 77	+0 039
1 01 to 2 34	22	6 2	1 50	+0 109

Notwithstanding the drop corresponding to a mean proper motion of 0" 77, a distinct connection between parallax and proper motion is manifested. This relation is the more marked when the proper motion exceeds one second In these cases there is a uniformly positive and generally appreciable value of the parallax

The connection between parallax and magnitude is not so marked, though fairly evident It is however, to be noticed that the average proper motion has progressed tolerably uniformly with the magnitude, and this progression tends to mask any effect due to magnitude alone

Range of Magnitude	No of Stars	Average Magnitude	Average Proper Motion	Average Parallax
0 0 to 1 5	10	0 8	0" 61	+0" 095
2 0 to 4 9	29	3 8	0 53	+0 066
5 0 to 6 2	33	5 6	0 63	+0 056
6 3 to 7 0	34	6 7	0 73	+0 045
7 1 to 7 9	31	7 6	0 68	+0 017
8 0 to 9 0	36	8 3	0 80	+0 047

Other tables show the results arranged according to parallax, in order of right ascension, and according to the spectral type and classes as given in the Draper Catalogue From the last table we may quote the following —

—	Type I All Stars	Type I Rejecting Doubtful Spectra	Type II All Stars	Type II Rejecting Doubtful Spectra
Magnitude	4 0	3 5	5 3	5 4
Proper Motion	0" 42	0" 42	0" 67	0" 70
Parallax	+0 065	+0 066	+0 058	+0 056
No of Stars	13	11	81	69

The exclusion of the stars with doubtful spectra affects very slightly the mean values for each type, and the authors remark that although the evidence to be drawn from Type I is not very strong, it scarcely supports the law deduced by Kapteyn of larger parallaxes for Type II

The authors are to be congratulated on having accomplished a valuable long-continued series of observations, admirably planned and carried to a successful conclusion

W E P

RUSSIAN SCIENTIFIC PUBLICATIONS

THE work of the great N M Prjevalsky the first explorer of Central Asia, has been continued by one of his pupils and lieutenants Mr P K Kosloff, whose portrait appears as frontispiece to vol I of the account of the expedition conducted by himself in 1899–1901 to Mongolia and Cham This volume is dedicated to the memory of the great pioneer, who projected a fifth journey which he did not live to accomplish As a member of former expeditions, Mr Kosloff was well equipped for the vast undertaking which he describes At the end of 1898 he submitted a plan for exploration of the southern or Mongolian Altai, the neighbouring central Gobi, and if practicable, of eastern and central Tibet The Imperial Russian Geographical Society and the Ministry of War warmly approved, invested Mr Kosloff with powers of command and discretion, and furnished the expedition with scientific instruments Under distinguished auspices the party made its way to the Altai station, and halted to survey the sublime snow-clad range and to collect specimens Here the members met with a venerable member of a company of Old Believers, Rachmanoff whose pilgrimages and adventures of more than forty years are mentioned by Prjevalsky Having achieved satisfactory results, the expedition moved into the arid, sandy wastes of Gobi, an unattractive region It met with a hearty welcome at the Tshortentan monastery from the lamas, whose personalities and the etiquette of their rule are described at length Next the party proceeded to the salt-marsh district of Tsaidam The Mongols of this region appear to have had a distinguished history, but in course of time were forced to cede territory to Chinese and Tibetans, their conquerors compelling them to destroy all documents and records of the earlier Mongol princes There is only local tradition to depend upon, without any means of verification A chapter is devoted to an ethnographical sketch of the Tsaidam Mongols, and in other chapters the author discusses Mongolian marriage customs and folklore A wallet of excellent maps, showing the routes taken by Prjevalsky and other explorers, is appended to the volume

An interesting account of exploration and observations in an uninviting region is given in Dr W N Tuchoff's volume on the western shores of Kamchatka In the preface, Mr K Bogdanovitch explains that the author, a medical student at Dorpat, had a strong desire to investigate the geographical conditions of Kamtchatka and spent ten years there almost without interruption No one but an ardent naturalist would be attracted to this vast area of volcanic ridges and tundra, of monotonous aspect The main interest lies in the descriptions of the life and occupations of the Kamtchadals, who are exposed to a hard struggle with nature and are suspicious of foreigners Dr Tuchoff relies chiefly upon diaries and data collected between 1896 and 1898, and on reports of the Amur section of the Imperial Russian Geographical Society Each chapter is devoted to the conditions of a particular district

Although fish is the staple food of the inhabitants and their dogs, the fishers do not exercise much judgment, and lament that catches are consequently less numerous The people are exceedingly simple and childish, as Dr Tuchoff shows by humorous stories, and Russian officials of routine temperament sometimes fail to understand them He devotes some space to their superstitions, *e g* the story of the brethren man and bear, and the divinity driven through the woods in a sledge drawn by partridges "The bear population of Kamtchatka," he quaintly observes "predominates over the human, and there are more chances of meeting a bear on the road and in the woods than a man," but with more numerous visits of hunters the bears retreat into the more inaccessible regions In one district mothers quiet refractory children by threatening them with the Russians in the same way as Border parents used the name of the "Black Douglas" Illumination of the poor dwellings is effected by means of bear or seal fat in a primitive kind of lamp, with moss or a piece of rag for a wick, the results being dismal light, much soot and foul air Dr Tuchoff urges the necessity for a series of meteorological observations with a view to the agricultural prospects, and indicates sites for stations Cattle-breeding a feature of settled life, is more developed where there is a Russian settlement, and the author's opinion is that the Kamtchadal native is in the transition state from nomad to settled habits and that he wants practical instruction in rearing of stock It is unfortunate that the natives degenerate when in proximity to the Russians The concluding chapter is devoted to the language, which varies in north and south, and appears to be dialectical Dr Tuchoff confesses himself unable to reproduce all the sounds of words, partly because European alphabetical resources are inadequate and partly because the ear can only distinguish some with difficulty The transliteration of lists of words in Russian and Latin characters is perplexing to the eye There is an excellent index and map at the end

Mr. N. M. Knipowitsch has compiled a volume of more than 1500 pages, embodying the results of much research, under the title of "Bases of the Hydrology of the European Ice-ocean" (i.e. Barents and the White Seas). The author proposes to give a full and exact picture of the physical geography of the ice-ocean, so far as that is possible at the present time, to record some deductions with regard to biology and geology, and to construct a firm groundwork for future investigations. He modestly leaves his conclusions open for future proof, but none the less must be congratulated on the accomplishment of this work, which will unquestionably be of great value to students of marine conditions. Accordingly Mr. Knipowitsch reviews previous literature, gives lists of temperature at many points, tables indicating degrees of saltness, differences of temperature according to depths, analyses of sea-water, its clearness and colour, with chapters on hydrology, biology, and geology, a series of about sixty practical deductions, and appendices. A short abstract in German appears at the end. The author refers to other works of his own, to Scandinavian authorities, *e.g.* Nansen and Pettersson, and to men of a former generation, as Scoresby, and the Siberian explorer Middendorf.

Vol. xxviii. of the Transactions of the Novo-Rossisk Society of Naturalists of Odessa, shows that the labours of a relatively small body have produced very important results. The work opens with an appreciation of the late president, Prof. R. A. Prendel. Botanists will delight in the exhaustive examinations during two summers by Mr. I. Okinshevitch of the forests of northern Bessarabia, which he says, "in spite of the rich and abundant nature of this country, is very little known from the natural history point of view." The Pliocene and post-Pliocene deposits in south Bessarabia are the subject of a study by Mr. Grigorovitch-Berezovsky. Mr. M. S. Pantchenko describes the hydrological work of the late Admiral S. O. Makaroff; it was he who finally settled disputed points with regard to the navigation of the Bosphorus, after careful survey, the cruise of the *Vitiaz* round the world resulted in the collection of comparative data from different seas; but Makaroff is perhaps best generally known as the designer of the ice-breaker *Yermak*. His untimely death deprived Russia of one of her greatest practical men of science. Mr. A. Brauner writes extensively on the reptiles and amphibia in several provinces. The volume concludes with the report of the society for 1904.

The Tungus race of Siberia has been studied by Mr. S. Patkanoff, who devotes a volume to the Tunguses proper and another to the Manzhurs, Daures, Solones and other tribes. The Russians first came into contact with the Siberian aborigines early in the seventeenth century, while the Cossacks were extending the conquests initiated by the famous Yermak in the reign of Ivan the Terrible. The Tunguses formerly occupied a large territory, but were driven northwards by the incursions of Buriats, Yakuts, and other Asiatics, as well as of Russians. The Cossacks observed that a certain amount of culture was known to the Tunguses, who wore iron helmets, shields and chain-mail in battle. The principal occupations of these people are breeding of deer, hunting, and fishing. The pure type is now difficult to trace owing to admixture with other races for some considerable period. Travellers have paid high tribute to their many excellent qualities in comparison with other Asiatics, especially as regards honesty. Middendorf found strong mountaineering characteristics among the Tunguses, probably survivals of an earlier period. Kastren styled them "the noblemen among Siberian tribes." Various tribes are dealt with as carefully by the same author in the second volume, which also contains notes on the languages and dialects with specimens, a map of Siberia illustrating the distribution of Tungus tribes, and another showing their position in the Amur region. This work evinces the thoroughness with which the Russians are studying and mastering the varying conditions and populations of the vast territories owning the Tsar as sovereign.

Messrs. B. M. Zhitkov and S. A. Buturlin have compiled an interesting volume of materials for the ornithology of the Simbirsk government, though they do not claim that it is exhaustive, and have not covered all the ground. The groups dealt with comprise Pygopodes, Longipennes, Limicolæ, Alectorides, Gallinæ, Columbæ, Lamellirostres, Herodiones and Rapaces. The area is largely broad, cleared steppe country, with a fauna such as might be expected in a corn-growing region. Oases of forest or grass land, with abundance of water at intervals, intersect the monotonous plains, and shelter corresponding forms of animal life. The authors have spent fifteen years in observation and collection of materials.

In a report on a geological investigation extending from Mukden to Liao-yang, shortly before the Russo-Japanese war, Mr. Y. S. Edelstein, a Russian explorer, writes:—"Many people consider Manchuria a country of extraordinary richness in minerals. This fame does not rest on sufficient evidence, as in the first place the question of quantities and qualities of useful minerals in Manchuria is still too little known, and in the next, even in the present condition of our knowledge of Manchuria, it is scarcely possible to doubt that many areas of Siberia, the Urals, and Europe surpass it in this respect." Auriferous sand, thanks to barbarous and primitive methods of working, loses the major part of its value in the eyes of a European contractor, and the extensive employment of modern machinery is the only way to secure advantage from working.

In his account of a botanical expedition in Ossetia and Colchis (Transactions of the Imperial Russian Geographical Society, vol. xxxviii., No. 3), Mr. V. V. Markovitch writes that the beech of the Ossetian forests, considered by botanists as being identical with the species *Fagus silvatica*, L., of western Europe, was discovered by Lipsky to be a new species and styled by him *Fagus orientalis*, Lipsky. Lipsky based his conclusions largely upon differences in fruit. Mr. Markovitch finds that the lignine of the Caucasian beech does not resemble that of *Fagus silvatica*. The German name *Rotbuche* is due to the colouring of the lignine after hewing, which does not occur in that of the Caucasian variety, which remains white.

THE BRUSSELS SOCIOLOGICAL SOCIETY.[1]

THERE are at the present day many earnest students of sociology. It is only natural, therefore, that we should find societies for the investigation of sociological questions springing up. The publications of the Instituts Solvay for 1906 are already fairly bulky, though as yet we have the output for the first half of the year only. There are seven "fascicules," the largest of which contains three hundred pages. One, possibly two, of the papers contained in them, though not to a great extent original, may be described as distinctly able. The aim of the first paper (by E. Solvay) is to prove that sociology must be founded on biology. Of course, if the nature of a society is to be investigated, it is well as a preliminary to learn all that is to be known about the individuals of which it is composed. It is well to make this clear at the outset, but it may be doubted whether anything is gained by arguing this out elaborately and mathematically.

The second paper (by E. Waxweiler) sketches the methods of sociology. A young science must, of course, try to be ultra-scientific. It is sure to be decried as an upstart that has no right to claim admission to the pantheon of the sciences. It is bound to insist that there shall be no vagueness of terminology, and that words shall be accurately used. Our author is quite right to emphasise the importance of such matters. When he goes on to deal with evolution, we find much with which we cannot agree. The struggle for existence he seems to count almost as a myth, and he would substitute for it the idea of "an irresistible tendency towards life." Such big, vague assumptions are far more unscientific than the casual methods which our author condemns. So at least it seems to the present writer. A little further on we find living organisms divided into three classes—"vegetables, animals and men."

The third paper (by R. Petrucci) is, like the second, a long one. It deals with the natural origin of property. The author is no doubt right when he maintains that, independently of legislation, there may be property and

[1] "Instituts Solway—Travaux de l'Institut de Sociologie." Parts 1–5 and 7. (Bruxelles and Leipzig: Misch and Thron, 1906.)

ownership When he goes on to assert that plants have property, that a plant "possesses a definite territory," he seems to be playing with words In the organ-pipe coral he finds an example of collective ownership, the individual polype also having something in the way of private property In animals of a higher class, e g in ants, the notion of property does undoubtedly show itself This paper is illustrated, and some of the pictures are excellent, but a picture of the nest of *Formica rufa* does not help us to understand the subject of property

The fourth paper (by L Wodon) is brief, and deals trenchantly with some sociological theories, notably with those of Karl Büchner, who maintains that primitive man was a non social being This creature of theory lived in lands where the abundance of natural products made any large output of energy on his part quite unnecessary Our author satisfactorily disposes of this primitive lotus-eater

Dr E Houzé has contributed a distinctly able paper (fascicule No 5) on the Aryan and anthroposociology He has a thorough grasp of his subject, his style is clear, and he has a fine sense of humour The wonderful theories of the comparative philologist he sends to the limbo to which such theories must sooner or later find their way He goes rather too far when he maintains that the Aryans were the creatures of the philologists It is true, no doubt, as he argues, that no race has ever maintained its purity for any length of time unless it happened to be geographically secluded The pure bred Aryan stock that we were taught to picture to ourselves ranging over great part of Asia and all of Europe is a myth But it is difficult to believe that the people who spoke the Aryan tongue in different parts of the world had not a fairly strong strain of kindred blood in them, though they intermarried freely with the tribes and peoples among whom they found themselves Still far too much has been made of the Aryans as a separate type, and Dr Houzé is right to laugh at what has been called "Anglo-Saxon pandolichocephalism" a term invented to describe "the skull which has the honour of sheltering the brain that has guided the world" M de Lapouge the champion of the "dolichocephalic blond Aryan" is very severely dealt with Dr Houzé is a strong believer in natural selection He keeps quite clear of the untenable view that it goes on in the organic world generally whereas among men it has somehow become a thing of the past "When the sun has baked the grass," he remarks "it forces innumerable troops of antelopes to migrate is not this the same cause that drives the Germans to embark at Hamburg for America? It is a question of food" Archæology he holds supplies the firmest foundation for anthropology, and he speaks with great respect of such men as de Morgan Arthur Evans, and Flinders Petrie Anthropometry he puts in its proper place Nothing can be more absurd as he says, than to make size of skull alone an absolute measure of brain capacity When he discusses existing populations and their characteristics Dr Houzé shows great soundness of judgment As to the question of town and country life he holds that the commonly held opinion that towns "devour their inhabitants with rapidity" is at any rate an exaggeration On the modernism of Teutonic civilisation he makes some very sensible remarks The Teutons appeared late on the stage of history and it was only their contact with Gallo-Roman civilisation that enabled them to reduce their legends to writing

The last of the papers we are reviewing (by R Petrucci) takes pains to prove that animal associations were developed independently of one another They do not form a series culminating in human communities In tracing the descent of birds and of men from simpler forms of life, the author shows a thorough understanding of the subject About animal societies he has much interesting information—about the sociability of reptiles about the form the family takes among fish birds, and mammals Apparently he does not point out (a curious omission) the interesting fact that the pairing instinct is strong only in those species in which the energy of both parents is required for the feeding or protection of the young We regret that we have not space to deal more fully with this last paper Those who are interested in animal associations would do well to study it

IS THERE DETERMINATE VARIATION?

IN an article published in *Science* of November 16, Prof Vernon L Kellogg, of Stanford University, discusses the question as to the existence among organisms of determinate variation, that is to say variation in the same or a similar direction in a large number of individuals of a single species If such a factor does exist one of the objections to the origin of species by natural selection—namely, that small individual variations would be eliminated in a generation or two—disappears

Prof Kellogg's observations refer to variation occurring in the Californian flower-beetle, *Diabrotica soror*, inhabiting the Stanford University "campus" Large series of this chrysomelid beetle, varying from 500 to 1500 in number, were collected on that area in the years 1895, 1901, 1902, 1904, and 1905 Normally, the beetle shows six dark spots arranged in pairs on each wing-cover Individuals show, however, a tendency to the transverse coalescence of the two middle or two lower spots on one or both elytra, or a longitudinal fusion of the three spots on each half of the elytron In 1895 the majority of the beetles had twelve free spots on the two elytra, but among the variations there was a marked tendency to the transverse union of the two middle spots, either on one or both elytra, the percentage being 22 40 In the years 1901–5 a much larger percentage of this variation occurred, reaching 53 92 per cent in one series in 1905 and 65 40 per cent in 1904

After adducing arguments to show that the variation is neither ontogenetic (that is, determined for each generation during development by external influences) nor the result of natural selection Prof Kellogg falls back on determinate variation "If" however he writes, "determinate variation is the explanation of this change in *Diabrotica soror* it is a determinate variation which is occurring only apparently, in our particular locality For in series of specimens of this beetle collected in other parts of California no such change seems to be going on the old twelve spots-free form being plainly the modal type Why the species should be changing on our university campus and not changing in the regions south and north of us is a mystery whose solution I do not even dare to guess it This solution must have to do with the cause of the variation of the species on our campus But if one asks what is this cause, what it is that is producing determinate variation in Diabrotica or in any other species it must be mentioned that prior to any attempt to explain how determinate variation might be produced it is advisable to attempt to determine if determinate variation really exists Is there determinate variation?"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

LORD CURZON OF KEDLESTON, who was appointed to be the Romanes lecturer at Oxford for 1906, but was prevented from delivering the lecture, has been appointed the Romanes lecturer for this year

MR WILLIAM SMITH of Geneva, has says *Science*, given 100 000*l* to Hobart College to endow a college for women It is also announced that Dr Andrew Carnegie has offered to give 20 000*l* to Queen's University, Ontario, on condition that an additional sum of 80,000*l* be collected

MR J D ROCKEFELLER has made a New Year's gift to Chicago University of about 600 000*l*, which brings his total benefactions to the University up to 3 900,000*l* The private gifts to universities and colleges in the United States announced in these columns during last year amounted to nearly 5 000,000*l*

THE annual meeting of the Public School Science Masters' Association will be held at the University of London on Saturday, January 12 The president the Rev the Hon E Lyttelton, headmaster of Eton, will take the chair, and will read a paper on the place of science and of literature in a general education Other subjects of papers upon which it is hoped discussion will take place are —"The Internal Economy of School Science" by Mr Thwaites, and "The Best Method of Introducing the Atomic Theory in Science" by Mr F R L Wilson

In connection with the University of London, we notice that Mr A G Tansley, assistant professor of botany and lecturer on plant anatomy at University college, will deliver a course of eight lectures on "The Evolution of the Vascular System in the Fern-phylum," beginning on January 26, at University College At the physiological laboratory of the University a course of eight lectures on "The Physiological Effect of Compressed Air" will be given by Mr Leonard Hill, F R S, beginning on January 15 A course of five lectures on the "Structure and Classification of the Myriapoda and Arachnida" will be given at University College by Mr R I Pocock, beginning on January 14

The Paris correspondent of the *Times* reports that M Briand, the French Minister of Education, proposes to suppress the baccalauréat, the degree conferred on a boy on his admission to a French university Such admission is of necessity preceded by several years' school training during which the boy is prepared in a somewhat mechanical manner for the examinations on which his admission to the university depends The system, according to the *Times* correspondent "is the nearest approach known in Europe to the mandarin method of China" It is very widely felt that at the end of their school careers the boys lack initiative and originality as the result of the undue appeal to their verbal memories, and it is hoped that the abolition of the baccalauréat will discourage the rigid uniformity which characterises French secondary schools and lead to an endeavour to adapt the curriculum of a school to the particular needs of the pupils attending it

Several substantial gifts for the advancement of higher education are recorded in recent issues of *Science* Among these may be mentioned donations of 20,000*l* each to Western Reserve University, Cleveland, O by Mr H M Hanna and Colonel Oliver H Payne The 40 000*l* thus subscribed is to be used in establishing and endowing a laboratory of experimental medicine in the medical school Mr William Smith of Geneva N Y is to found a woman's college The name of the new college will be the William Smith College for Women, and it will have an endowment of about 70 000*l* A "Carl Schurz memorial professorship" is to be established at the University of Wisconsin as a result of the movement recently started in Milwaukee by a number of prominent German Americans The plan is to raise an endowment of 10,000*l* the income of which will be used for the establishment of an annual course of lectures at the State university to be given by prominent professors of German universities Mr Andrew Carnegie has offered to give Washburn College, Topeka Kans a second 10 000*l* for its endowment fund, provided the total endowment reaches 40 000*l* by January 1, 1908

The tenth of the series of articles on "Public School Education" which is being published in the *Times* appeared on December 28, 1906 This contribution deals with laboratories and practical work in the teaching of science and is by the Rev T Nicklin, of Rossall School Mr Nicklin says "it would be hard to find a single public school of recognised position that has not a laboratory which if not palatial is yet adequately equipped for that end of science teaching that is regarded in England as educationally best" A little later the article asserts that while the masters in the public schools adhere to the theory that lectures and intellectual teaching must be the staple of the work, the English public schools have from the first made considerable use of the laboratory, and to-day that use is on a larger scale and more thorough in character than ever before Mr Nicklin describes the laboratories of an average public school, and indicates briefly the course of study followed Though it would have been more satisfactory if in addition to his generous estimate of Prof Armstrong's work in improving English science teaching Mr Nicklin had insisted more upon the paramount importance of laboratory practice in the teaching of science, his article is valuable in showing the very substantial improvement made during recent years in the way in which science is regarded by public-school authorities Many readers of NATURE will remember the days when any sort of practical lesson was unknown in public schools and to hear that every such school now has well-equipped laboratories—even if in some cases they are not used enough—is convincing proof that the labours of men of science in the direction of rationalising English public-school education have not been in vain.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, December 11, 1906 —Dr H Woodward, F R S, vice-president, in the chair —An account of the ascidians of the Cape Verde marine fauna collected by Mr Cyril Crossland Dr J **Rennie** and H **Wiseman.** The occurrence of ten species of Ascidiæ Simplices was recorded, of which three were described as new —Variations in the arterial system of certain species of Anura L K **Crawshay.** —Descriptions of fifty-three new species of African Coleoptera of the family Curculionidæ Guy A K **Marshall.** —The cranial and spinal nerves of *Chlamydoselachus anguineus* Mrs O A Merritt **Hawkes** The paper contained a description of these nerves and discussions of them from the point of view of the nerve-component theory, and showed that the nervous as well as the other systems of Chlamydoselachus combined specialised and primitive features —Two mammals obtained by Major Powell-Cotton in the Ituri Forest R **Lydekker** The author referred a dark-coloured cat's skin to a race of *Felis chrysothrix* and also described a giant elephant-shrew as new —The skull of a bruang, or Malay bear, from Tibet representing a distinct race R **Lydekker** —South Indian nudibranchs Sir Charles **Eliot.** A supplementary account of the radulæ of various species based on microscopic slides prepared by Alder and Hancock, discovered in the Hancock Museum at Newcastle-on Tyne These slides confirmed many of the identifications suggested in the first paper, and in particular showed that *Doris glenei* was a Chromodoris, and that *Doris villosa* was *Thordisa maculigera*, Bgh

Faraday Society, December 11, 1906 —Dr T M Lowry in the chair —Contributions to the study of strong electrolytes Dr A C C **Cumming** (1) *The Elimination of Potential due to Liquid Contact* —Certain solutions have the property of reducing the potential due to the contact of two solutions and potassium chloride has been used for this purpose In most cases a saturated solution of potassium chloride does not remove all the diffusion potential indeed if the solutions in the cells be strong, it only removes a small part This property of removing more or less of the diffusion potential depends on two factors in the connecting solution first, the positive and negative ions must be of equal velocity, and, secondly, the concentration of the connecting solution must be high compared with the solutions in the cells The author suggests a saturated ammonium nitrate solution as that which fulfils these two conditions better than anything else at present known, and shows by experiments with different cells that this is the case (2) *The Potentials of Silver Nitrate Solutions* —For silver nitrate the electromotive force gives the same measure of the ionic concentrations as is obtained from the conductivities, and therefore supports the view that the conductivity gives a true measure of the ionic concentration —The electrochemistry of lead Dr A C C **Cumming.** The results in general prove that lead in the tetrad form is a highly electropositive element, and also direct attention to a curious difference in the behaviour of sodium and potassium nitrates towards lead nitrate —Storage batteries and their electrolytes R W **Vicarey.** The paper deals chiefly with some of the problems involved in the manufacture of accumulators particularly as regards the effect of nitrogen and other impurities introduced consciously or by accident in the process of manufacture

PARIS

Academy of Sciences, December 24, 1906 —M H Poincaré in the chair —The determination of integrals of equations of the elliptic type by certain conditions at the limits Émile **Picard.**—Differential equations of the second order at fixed critical points Paul **Painlevé.**—Magnetic work at the town of Tananarivo and district Ed El-

Colin. A table is given showing the results of the magnetic observations at twenty stations, to which is appended a discussion of the perturbations.—The evolution of the Tertiary mammals: the importance of migrations. The Miocene epoch: Charles **Depéret.**—The perpetual secretary announced the death of Jean Abraham Chrétien Oudemans, correspondant of the academy for the section of geography and navigation, and of Jacques Augustin Normand, correspondant for the same section.—The nature of the atmospheres of Mercury and Venus: P. **Salet.** Details are given of the method of observation by which it has been found that the light from Mercury is not sensibly polarised. It was shown by Landerer in 1892 that the light from Venus is similarly not polarised. The author concludes that it would be premature to draw conclusions as to the nature of the atmosphere of Mercury from this result.—A formula applicable to the times of direct rotation of the planets and the sun: Émile **Belot.** The formula proposed is

$$T = \frac{23.75}{\sqrt{a}\, D^{\frac{1}{17}}} + \frac{0.61D}{\sqrt{d}},$$

where T is expressed in hours, a is the distance from the centre of the system, D the diameter of the planet in diameters of the earth, and d the density with respect to water. The times are calculated from this formula in ten cases and the causes of the two large deviations observed, the sun and moon, discussed.—A method in the calculus of variations: M. **Hadamard.**—Partial differential equations of the second order with two independent variables admitting a group of odd order of transformations of contact: J. **Clairin.**—The extinction of friction: L. **Lecornu.** The motion is considered of a system of homogeneous spheres having their centres fixed, and which exercise given mutual pressures at their points of contact. It is shown that this system, once set in motion and left to itself, has the peculiar property that the work of friction, with respect to the unit of time, tends constantly to diminish. This theorem still holds when, for one or more of the points of contact, the sliding is replaced by a rolling.—The unsymmetrical modification of some absorption bands of a crystal under the action of a magnetic field: Jean **Becquerel.**—The variation of ferromagnetism with temperature: Pierre **Weiss.** A theory of ferromagnetism is given based on a simple hypothesis concerning the mutual actions of the molecules. Experiments have been carried out on magnetite, which previous experiments had shown to be sensibly saturated in a field of 500 Gauss, and of which the temperature corresponding to the disappearance of magnetism, 587° C., is easily accessible. The curve drawn from the theory is given, and on the same diagram ten experimental points are shown. The correspondence is very close at one temperature only, that of solid carbonic acid, there being a sensible deviation from the curve.—The negative charge at a distance of a metallic plate illuminated in an electric field: Mme. **Baudeuf.**—The cryoscopy of colloidal solutions of ferric chloride: G. **Malfitano** and L. **Michel.** The authors have shown the possibility in previous papers of using a collodion filter to separate the fine particles from the liquid in which they are suspended, and in the present paper apply this method to determine the lowering of the freezing point of the latter, considered apart from the small particles. In this way they find that the cryoscopic effect of the suspended particles is so small as to be beyond experimental measurement. In this case, at any rate, the magnitude of the suspended particles cannot be determined by cryoscopic methods.—The absolute atomic weight of dysprosium: Gustave D. **Hinrichs.** A discussion of the experimental results of G. Urbain. The atomic weight of dysprosium is assumed to be 162.5 exactly, the experimental figures and those based on this assumption are compared, and the deviations noted.—A colloidal compound of thorium with uranium: Béla **Szilard.** The compound described is obtained by heating precipitated thorium hydrate with solutions of uranium salts.—The action of alkaline silicates on soluble metallic salts: Robert **Dollfus.** A description of the phenomena observed when a crystal of ferrous sulphate is thrown into a solution of sodium or potassium silicate. The experiment has some analogies with the culture of the artificial cell described by Traube and by Stéphane Leduc.—The definite compounds formed by chromium and boron: Binet **du Jassonneix.** The ingots obtained by reducing chromium oxide by boron in the electric furnace contain two compounds, Cr_3B_2 and CrB, both of which dissolve in a medium containing less boron, and which can only be isolated in a state of purity from nearly homogeneous ingots, the composition of which nearly corresponds to the substance required.—The anhydrous protoxides of the alkaline metals: E. **Rengade.** By applying to rubidium, potassium and sodium the method previously used to obtain the oxide of cæsium, Cs_2O, the lower oxides of these metals, possessing the general formula R_2O, have been obtained in a pure state.—Some sulphates of tetravalent vanadium: Gustave **Gain.**—The use of special steels for rivets: G. **Charpy.** A systematic study of the thermal and mechanical properties of various alloys of steel has led to the use of a chrome nickel steel for rivets, the strength of which is 2.5 times that of the metal usually employed for this purpose, and this without the need of any special precautions in practical use.—Some methods of estimating nitriles and carbamines: H. **Guillemard.**—A new method for estimating free sulphur: E. **Berger.** The sulphur is dissolved by fuming nitric acid to which a little potassium bromide has been added. This reagent acts in the cold, and in a few minutes.—The molecular weight of elaterine: A. **Berg.** The author has repeated his determinations of the molecular weight of elaterine, with the result of confirming his earlier views. The formula would appear to be $C_{28}H_{38}O_7$.—Contribution to the study of the hydroxamic acids: R. **Marquis.** Benzhydroxamic acid treated with thionyl chloride, gives phenyl isocyanate by a kind of Beckmann transformation. Salicylhydroxamic acid behaves differently, oxycarbanil being quantitatively formed.—A new method of formation of organic compounds of phosphorus: J. **Berthaud.** White phosphorus, heated with an alcohol in a sealed tube at 250° C., after some hours completely disappears. Among the products of the reaction are phosphines, hydrogen phosphide, some phosphinic acids, and tetralkylphosphonium hydrate, the latter being the chief product.—The experimental reproduction of lithospherical folding: M. **Hirtz.** The effects of the gradual contraction of a planet are imitated by a layer of paraffin enclosed between two distended rubber spheres, the internal one being slowly deflated, and the contact of the external sphere with the paraffin being maintained by external pressure. The surfaces thus produced are compared with the surface of the moon.—The origin of helicoidal windings in crystallised bodies: Fred. **Wallerant.**—Corrosion figures: P. **Gaubert.** A study of the corrosion figures produced on phthalic acid crystals by mixtures of alcohol and water.—A new mineral species, nepouite, a hydrated silicate of nickel and manganese: F. **Glasser.** The mineral was found in New Caledonia. The analyses lead to the composition $2SiO_2.3(Ni,Mg)O.2H_2O$. The name of nepouite is proposed from the place Nepoui, the locality where it was first observed.—The experimental reproduction of the mycetoma with black seeds: E. **Pinot.**—The nature of the latent life in seeds and on the true characters of life: Paul **Becquerel.**—Luminous radiations and the richness of wheat in nitrogen: J. **Dumont.** The radiations at the blue end of the spectrum are those possessing the greatest effect in causing the migration of nitrogenous materials, especially gluten, in seeds.—The influence of the valency of metals on the toxic power of their salts: Henri **Micheels.**—The genesis of proteid materials by a pathogenic microorganism at the expense of definite chemical substances: J. **Gallimard** and L. **Lacomme.**—A new species of the genus Icticyon (Speothos) coming from the equator: E. L. **Trouessart.**—The influence of the geographical situation on the development of height in man: Eugène **Pittard.** A study in the Canton Valais, Switzerland, of the effects of soil, altitude, and aspect upon the human height.—Researches on nutrition balance of nitrogen and common salt: M. **Letulle** and Mlle. M. **Pompilian.**—An apparatus for administering chloroform. The Roth-Drœger apparatus: M. **Guglielminetti.** The regular distribution of chloroform in the tissues when using an air-chloroform mixture of known proportions is based on the assumption that the breathing is regular. The apparatus

described permits of the administration of a given quantity of chloroform in a given time, whatever may be the respiratory activity —The preservation of chloroform, and an arrangement indicating its accidental alteration Pierre **Breteau** and Paul **Woog**. Pith tinted with Congo red is recommended as the most practical means of detecting acid alteration products in chloroform —The physiological action of Euphorbium resin L **Pénières** —The nature of vaccine virus H **Nicolle** and M **Adil-Bey** —The causes of alteration of butter The bacteriological control of butter manufacture M **Mazé** —The geological constitution of the Chézery region Attale **Riche**

CALCUTTA

Asiatic Society of Bengal December 5, 1906 —The common kestrel (*Tinnunculus alaudarius*) Lieut Colonel D C **Phillott** Note on the breeding and distribution of this bird in India, its use in Persia as a decoy for hawks, its employment by the Arabs for training greyhound puppies destined for the sport of gazelle-hawking —Note on the falcon (*Falco jugger*) Lieut-Colonel D C **Phillott**. Note on habits breeding prey, and use in falconry, with a detailed description of and a figure illustrating its use as a *baral* or decoy with nooses, by Indian hawk-catchers *Swertia tongluensis* and a new variety of *Swertia purpurascens* I H **Burkill** Records the result of observations in the field upon the difference between *Swertia tongluensis* and *Swertia Chirata* Both plants are equally bitter The new variety of *Swertia purpurascens* was collected in the Sikkim Himalaya It differs from the type in several features, and the finding of it extends the range of the species to the east of Nepal —Hunting-dogs from an Arabic manuscript of the fourth century Lieut Colonel D C **Phillott** and R F **Azoo**.—A specimen of *Felis tristis* Milne-Edwards, in the Indian Museum N **Annandale** The skull of this rare cat is figured and described from a specimen of unknown *provenance* The most characteristic feature of the dentition is the high development of the anterior præmolar —Miniature tank worship in Bengal A N **Moberly** —The Rajmahal hill folk The Saorias of the Rajmahal Hills R **Bainbridge** —Fresh water fauna of India No 11 The occurrence of the medusa *Irene ceylonensis* in brackish pools together with its hydroid stage N **Annandale** This medusa has been found, with its hydroid stage in pools in the Ganges delta which probably contain about one third of the proportion of mineral salts commonly present in sea water —Fresh water fauna of India No 12 A preliminary note on the Polyzoa occurring in Indian fresh water and brackish pools with the description of a new Lophopus N **Annandale** *Victorella pavida* is recorded from near Calcutta the "species" of Plumatella (*P repens P emarginata* and *P allmani*) occurring in India are discussed, and a Lophopus distinguished from *L crystallinus* by the shape of its statoblasts is described from a lake in the outer Himalayas

DIARY OF SOCIETIES

THURSDAY, JANUARY 3

ROYAL INSTITUTION, at 3 —Signalling to a Distance the Telephone and its Working W Duddell

FRIDAY JANUARY 4

LONDON INSTITUTION, at 4 —Earthquakes and Geysers W Herbert Garrison

ROYAL GEOGRAPHICAL SOCIETY, at 3 30 —Japan and the Japanese as I saw them Miss A L Murcutt

SATURDAY, JANUARY 5

ROYAL INSTITUTION at 3 – Signalling to a Distance Early Wireless Telegraphs W Duddell

GEOLOGISTS ASSOCIATION, at 8 —On a Norwegian Snowfield and its Glaciers Horace W Monckton

MONDAY, JANUARY 7

ROYAL GEOGRAPHICAL SOCIETY, at 3 30 —A Lady's Journey from the Cape to Cairo Miss Mary Hall

SOCIETY OF CHEMICAL INDUSTRY, at 8 —The Sixth International Congress of Applied Chemistry at Rome Walter F Reid

VICTORIA INSTITUTE at 4 30 —The San Francisco and Valparaiso Earthquakes and their Causes. Dr Warren Upham

TUESDAY JANUARY 8

ROYAL INSTITUTION, at 3 —Signalling to a Distance The Radio Telegraph W Duddell

INSTITUTION OF CIVIL ENGINEERS, at 8 —The Simplon Tunnel Francis Fox

WEDNESDAY, JANUARY 9.

SOCIETY OF ARTS, at 5.—Perils and Adventures Underground? Bennett H Brough

GEOLOGICAL SOCIETY, at 8 —On the Cretaceous Formations of Bahia (Brazil), and on Vertebrate Fossils collected therein J Mawson and Dr A S Woodward, F R S —On a new Dinosaurian Reptile from the Trias of Elgin Dr A S Woodward, F R.S

THURSDAY, JANUARY 10

MATHEMATICAL SOCIETY at 5 30 —Exhibition of Four-dimensional Models Mrs A Stott —On the Uniform Convergence of Fourier's Series Dr E W Hobson —Asymptotic Approximation to Integral Functions of Zero Order J F Littlewood —Partial Differential Equations of the Second Order having Integral Systems free from Partial Quadratures Prof A R Forsyth —On the Singular Points of Some Classes of Power Series in Several Variables G H Hardy —The Construction of the Line drawn through a Given Point to meet Two Given Lines Prof W Burnside

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—New Incandescent Lamps J Swinburne.

FRIDAY, JANUARY 11

INSTITUTION OF CIVIL ENGINEERS, at 8 —The Balancing of Internal combustion Motors applied to Marine Propulsion A T Weston

ROYAL ASTRONOMICAL SOCIETY, at 5

MALACOLOGICAL SOCIETY, at 8 —Descriptions of New Species of Achatina from the Congo Free State S I Da Costa —Further Contributions to the Genus Chloritis, with Descriptions of Eleven New Species G K Gude —Description of a New Species of Papuina, and Illustrations of some hitherto unfigured Helicoid Land shells G K Gude.—Descriptions of new Non marine Shells from New Zealand Henry Suter

SATURDAY, JANUARY 12

ROYAL GEOGRAPHICAL SOCIETY (at The Queen's Hall, Langham Place), at 8 45 —The Duke of the Abruzzi's Expedition to Mount Ruwenzori

PUBLIC SCHOOL SCIENCE MASTERS ASSOCIATION (University of London), at 2 30 —The Place of Science and of Literature in a General Education Rev and Hon E Lyttelton —The Internal Economy of School Science Mr Thwaites —The best Method of Introducing the Atomic Theory in Science F R I Wilson

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THURSDAY, JANUARY 10, 1907

INDIAN CLIMATOLOGY.

Climatological Atlas of India Published by the Authority of the Government of India, under the Direction of Sir John Eliot, K C I E, F R S Pp xxxii + 120 plates (Issued by the Indian Meteorological Department, 1906) Price 36s

THE Indian network of meteorological observations is the greatest individual organisation within the tropics, and it has, therefore, attained the greatest importance in the pursuit of meteorology and climatology Founded in the year 1875, it can now look back upon more than thirty years of uninterruptedly successful activity, having during this period had the peculiarly good fortune to be presided over by two distinguished meteorologists—Henry F Blanford and Sir John Eliot From the commencement the author of this review has followed with sympathetic interest the development and the active work of the organisation, has been in constant association with its director, and has also, as far as possible, made use of the immense volume of information In no meteorological organisation in the world are there such comprehensive records, as well of a statistical as of a scientific nature, as in the Indian one, only the much older Russian one can compare with it Beginning with the smaller, but very valuable, scientific essays of Blanford in the Proceedings of the Asiatic Society of Bengal, it grew into the huge folio volumes of the Indian Meteorological Memoirs, of which the seventeenth volume is completed and published Then came monographs relating to individual cyclones, Blanford's "Indian Meteorologist's *Vade Mecum*" (Calcutta, 1877), and especially the five volumes of cyclone memoirs by Sir John Eliot, and his "Handbook of Cyclonic Storms in the Bay of Bengal" (second edition Calcutta, 1900)

The introductory text to the "Climatological Atlas" gives a summary of the publications of the Meteorological Department, relates the history of the development of the department, and describes its objects and aims Reference may here be permitted, to an older publication, "Memoirs of the Indian Surveys," by Sir Clements R Markham, K C B, F R S (second edition, London, 1878 xvi, pp 275–310), in which is minutely described the beginnings of meteorological efforts in India, down to the establishment under Blanford of a single organisation, it also gives a very good analysis of the meteorological work until the year 1875 The text of the "Atlas" contains the most important facts as to the principles on which the construction of the charts is based, the means are critically derived from the observations of the twenty-five years 1876–1900 [1]

The Indian network of meteorological observations extends from about latitude 6° N, in the tropical Indian Ocean, to the prodigious plateaus of the Himalayas, under 35° N It includes, in the south as well as in the north, hill stations at and above 6000 feet above sea-level, which supply information on the upper strata of the atmosphere The region contains the hottest and the most rainy parts of the world, and it is the scene of one of the most peculiar meteorological phenomena—the south-west monsoon—in which the wind *régimes* of the two hemispheres meet between 30° S and about 30° N

From the accumulated meteorological records in this highly interesting region we have now this splendid chartographic production, the "Climatological Atlas of India" This work excels in its completeness even the similar work the "Atlas Climatologique de l'Empire de Russie" (St Petersburg, 1900) In a certain sense these two great works are complementary to each other, giving us such a very extensive picture of the climatic variations over the largest continental area of the world—Asia and Europe—as one would hardly have hoped for a short time ago The "Indian Climatological Atlas" contains a very valuable peculiarity—it takes into consideration the *daily* variation of the meteorological elements, explaining their extension over the country during the extreme day hours 8 a m (10 a m for pressure) and 4 p m, and also the daily variations of pressure and temperature In India these daily variations play a most important part The smaller charts complete in a clear manner the information on the large charts, and they are of very great practical value

The "Atlas" contains 120 charts in perfect technical finish, as is expected from Bartholomew's Geographical Institute The first chart (double) exhibits in a very excellent manner the orographical features of the Indian Empire the knowledge of which is very important for the understanding of the progress of meteorological phenomena over them Another two page chart shows the political divisions of India, influencing the selection of the meteorological stations Then come four smaller maps, showing the rainfall divisions according to Blanford and Eliot respectively the medical provinces, and the meteorological divisions for the Daily Weather Report Upon these introductory representations follow a couple of double-page maps showing the distribution of the pressure and the winds in the opposite months January and July These charts embrace the whole of India and the East African and Australian monsoon regions, extending from 35° S to nearly 50° N, from Asia Minor and East Africa in the west to Japan and the greater part of Australia in the east With these we are in a position to see at a glance the distribution of pressure with the north-east and with the south-west monsoons Both charts are very instructive, and particularly the July one, for it shows the origin and advance of the south-west monsoon of western India, which Sir John Eliot first completely explained A uniform decrease of pressure prevails then from the south Indian Ocean, under 30° S up to the foot of the Himalayas, in 30° N, with a difference of pressure of close upon an inch (30 3 inches in the south and 29 4 inches in the Punjab) The wind systems of

[1] The complete numerical values are found in various volumes of the Indian Meteorological Memoirs

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the southern and northern hemispheres unite, and there is no longer a division at the equator This is the great summer monsoon of southern Asia, which in the whole world has nothing to compare with it

In this, as in succeeding pressure charts, it is seen that in many places the winds recorded are in opposition to the distribution of pressure (local disturbances?) In the January chart we miss the north-west monsoon over the Malay Archipelago (it is found over North Australia), although at Batavia, for example, west, north-west, and north winds prevail in January with a frequency of more than 80 per cent, and similarly also prevail in strength

Plates xi-xxiii exhibit the distribution of mean pressure and the winds for each month and the year at 8 a m, the hour of observation for the telegrams for the Daily Weather Report Besides these there are two smaller charts showing the pressure and wind at 10 a m and also at 4 p m, that is, at the hours of the daily extremes In the quiet, cool-weather season the winds experienced undergo changes of direction in accordance with the distribution of pressure In the Ganges valley, in May, at 4 p m, they appear to blow against the gradient, that is, from the lower to the higher pressure, the problem of the nor'-westers, which had already occupied the attention of Blanford

Plates xxiv-xxxvi show the mean pressure and the winds for the day, the smaller charts the actual diurnal range of pressure, and the range reduced to sea-level, monthly and annual From January to May, in southern India, the daily range of pressure is as much as 0 15 inch to 0 17 inch, during and after the rainy season it diminishes to 0 13 inch or 0 12 inch These great daily amplitudes justify the representation of the mean daily distribution of pressure In Plates xi-xxxvi the monthly and annual isobars are drawn at intervals of 0 05 inch, an interval which would be ample for Europe, but for a tropical region it appears to be too large The pressure gradient which sets the great south-west monsoon in motion does not amount to so much as 0 02 inch per degree We see, therefore, upon some charts—February, March, October, and November—only two to four isobars over the whole of the extensive region, and sometimes it is not very clear as to the local decrease of pressure, especially over the Bay towards the east This could have been easily remedied by specially noting the mean pressure at the Nicobars, Andamans, and on the coast of Burma

As to the origin of the most interesting phenomenon in the meteorology of India—the bursting of the monsoon—the charts which lie before us cannot afford sufficient explanation, for the origin lies outside the limits of the charts, far southward in the Indian Ocean, not over the Indian land region, as Sir John Eliot pointed out (Quarterly Journal of the Royal Meteorological Society, January, 1896) The gradual advance of the southern and western sea breezes in the mighty south-west monsoon we see in the charts for February and March to June The south-west monsoon reaches Ceylon about the middle of May, and arrives at Bombay about the middle of June So gradual does the advance seem from April to May and from May to June that it is scarcely noticeable in the charts, but we do, however, find an indication. On the May and June charts we see a higher pressure advancing from south and south-west, while in northern India pressure is decreasing A pressure wave spreads over India from May to June This is clearly shown in the following pressure changes from month to month —

		Changes from		
		April-May In	May-June	June-July
Zanzibar ..	6 12 S	+0 066	+0 009	+0 019
Colombo	6 54 N	−0 014	+0 009	+0 016
Trivandrum .	8 30 N	−0 007	+0 003	+0 009
Mooltan	30 12 N	−0 149	−0 147	−0 019
Dera Ismail Khan	32 0 N	−0 145	−0 161	−0 013

From May to June southern India is flooded with masses of air from the ocean by the south-west monsoon, while over north-west India pressure continues to give way

Plates xxxvii-xlix contain the monthly and annual mean temperatures over India, the isotherms being drawn for differences of 0° 5 F, and are, therefore, of an especial distinctness The smaller charts give the lines of equal mean monthly and annual maximum and minimum temperatures The succeeding plates, l-lxii, are also devoted to temperature, the large ones showing the lines of equal diurnal range, the small ones the lines of equal absolute maximum and minimum values, monthly and annual The whole of these plates, therefore, afford a very complete picture of the temperature of India From the isothermal charts we can easily follow the warming of the Indian land area from south to north-west In February the warm centre, 82° 5, lies under 16° N (mean), in March, 87° 5, under about 17° N (the middle of the peninsula), in April, 92° 5, under 21° N, in May the centre, 95°, embraces the whole of western India, reaching from 18° to 27° N In June it takes up a position towards the north-west, in the Punjab—the Mooltan region—with 97° 5, one of the highest monthly temperatures in the world In July the cooling sets in, 95°, and in August it is 90°, whilst on the Malabar coast, under the influence of the rains, the temperature is already down to 77° (in 12° to 16° N) In the northern Punjab, where the heat centre lay in June, the temperature sinks to 55° (down to 52° 5) in January There also are to be found the absolute extremes of the whole of India 125° in June and 30° to 25° in January The daily range of temperature varies between 10° on the southern coasts and 32° 5 in the north-west The rainy season brings to the whole country a great decrease of the daily range of temperature, from 30° and 32° 5 to 15° in Central India

Plates lxiii-lxxv show the distribution, monthly and annual, of the mean daily relative humidity, the two smaller charts on each sheet the distribution at 8 a m and 4 p m In the Central Provinces in April the atmospheric humidity decreases to 30 per cent in the daily means, and to 20 per cent at 4 p m, whilst on the coast it is 70 per cent, and in Upper

Assam 80 per cent On the west coast during the rainy season it is 90 per cent, in the Punjab 50 per cent to 60 per cent In similar manner Plates lxxvi–lxxxviii, show the mean distribution of aqueous vapour, monthly and annual, and at 8 a m and 4 p m, the changes are mostly the reverse of those of relative humidity The mean vapour pressure reaches 0.90 inch to 0.95 inch on the coasts and over the Bay of Bengal in May, while in January it is only 0.40 inch over the land The rainy season brings to the whole peninsula a high vapour pressure, but on account of the decrease of temperature it is generally not higher than 0.85 inch, only in the lower and middle Ganges valley is it 0.95 inch The daily variations of the relative as well as of the absolute humidity are very great in the dry season

The charts exhibiting the distribution of humidity are followed by Plates lxxxix–ci, showing the mean daily cloud distribution Here also we find smaller charts representing the cloudiness at 8 a m and 4 p m Such an exhaustive picture of cloudiness as we have presented to us in these Indian charts did not hitherto exist for any part of the world The difference in the cloudiness in various parts of India in the several seasons is very great In the middle Indus valley we find a mean cloudiness of 1.5, in Upper Assam of 6.0—these are the extremes in the annual means In June the Punjab has still only 1.0, the Malabar coast and Assam 8.0, in western Bengal even 9.0 In October the minimum, 0.5, lies in the Punjab, the maximum, 8.0, in southern Deccan The technical finish of these maps is especially beautiful and impressive

We now come to the concluding series, Plates cii–cxx, representing the rainfall conditions The principal charts, monthly and annual, show the rainfall distribution by means of isohyets, the smaller ones give the lines of equal mean number of rainy days and the storm tracks for 1876–1901 Until now no monthly rainfall charts for India had been in existence H Blanford had added to his great work on the rainfall of India ("Memoirs," vol iii) merely an annual chart The principal areas of rainfall in India—the Malabar coast and the Khasi Hills of Assam, with from 200 inches to 450 inches of rain annually—are generally well known, but what we regard as the most extensive rain region is the Malabar coast rather than the Khasi Hills, as is especially evident from the June and July charts On the Malabar coast in July we find a long area with 50 inches of rain, whereas the Khasi Hills have only the isohyet of 20 inches (Cherrapunjee omitted) In June both regions have isohyets of 30 inches The driest region is in the lower Indus valley (round the hottest place in India—Jacobabad), with an annual total of only 5 inches The mean values of the number of rainy days lie between the limits of 10 on the lower Indus, 125 on the Malabar coast (Cochin) and in Assam, and 200 in the south-west part of Ceylon The isohyets are also drawn for the seasons—for January and February, March to May, June to October, and November and December (the main annual Indian seasons), and also for the combined results for December to April and for May to November The smaller charts show the number of rainy days, and for January, May, July, and October the midday isobars at an elevation of 10,000 feet On the chart for January and February appear the welcome rains of northern, and especially north-western, India, shown by isohyets of from 2 inches to 5 inches, on the March to May chart the spring rains in Assam, from 20 inches to 30 inches, and on the west coast of Ceylon, 20 inches, are particularly noticeable

Of special interest are fifteen smaller charts giving the storm and cyclone tracks (period 1876–1901) In the winter half of the year, the cool season, we find the storm tracks (paths of the depressions) in north India, mostly north of 24° N First, in November there are two, in December thirteen storms in the direction from the lower Indus towards the Ganges delta In January there are more than thirty northward of 24° N, while there are only four southward to 20° N In February they still remain in northern latitudes, we see two main paths with twenty-five tracks—in March not more than twelve This seems to be the end of the period of winter storms in north India On the April chart we already find the tracks of four great cyclones over the Bay of Bengal, the Arabian Sea and from the latter two advancing towards north-western India To the cyclone tracks are attached the dates, so that the direction and velocity can be ascertained, but with the storm tracks we miss an indication of the direction of movement of the depressions (say by means of an arrow) We certainly know that in the winter half-year in northern India these tracks are generally directed from west to east, but as we proceed through the year there are doubtful cases, as the summer depressions from the Bay up to the Ganges valley and westward towards Central India In May, and again in October and November, we find numerous tracks over the Bay, in November also over the Arabian Sea In this month two cyclones crossed the peninsula, and, therefore, the Ghats, from the Bay to the Arabian Sea (between 12° and 14° N)—rare cases In December only one great cyclone moved up the Bay from south to north, and some smaller ones from east to west During the rainy season (June to September) the upper north-west corner of the Bay becomes the birthplace of numerous depressions, which pass into the country In September this "area of cyclonic storm generation" extends further south to 15° N, and also goes further into the Bay These are the storms which carry the rains of the Ganges valley upwards and over Central India During the months of June to August it appears that even on the land depressions are developed which go westward (direction of movement wanting) as far as the Indus Three small charts show these land-formed storm tracks (period 1886–1900)

We now conclude our cursory examination of the very richly-stored volume of charts lying before us, for which science as well as practice, so long as they have to depend upon climatic factors, are indebted to the Indian Government Sir John Eliot, the author of this work, has produced a worthy monu-

ment of himself as the director of the Meteorological Service of India. We now look forward with the greatest interest to the promised "Manual of Indian Climatology," which, as an addition to the "Atlas," and especially in the interest of the general public, is indispensable. Our knowledge of the meteorology of India has now extended so far beyond the region of the instructive and concise work of Henry F. Blanford, "Climate and Weather of India" (London, 1889), that a new description on a broader foundation appears to us an absolute necessity.

J. HANN.

A NEW TREATISE ON EVOLUTION

Einführung in die Descendenztheorie. Sechs Vorträge. By Prof. Karl Camillo Schneider. Pp. viii+147. (Jena: Gustav Fischer, 1906.) Price 4 marks.

THIS is a book with many good points. It gives a fairly complete account of current opinion on the subject of evolution, including the most recent views concerning the nature of variation and the laws of inheritance. Most of the facts cited are sufficiently familiar, but they are explained with unusual lucidity and conciseness. Where authorities differ, their conclusions are as a rule impartially stated, and when, as often happens, the author's own judgment is at fault, he will generally be found to have supplied his readers with material for forming a sounder opinion. The illustrations are copious and well-selected, and the book as a whole will serve as an adequate introduction to modern evolutionary theory.

So far as argument goes, the most effective part of the work is its criticism of Lamarckism, from which, however, we miss any mention of Prof. Ray Lankester's convincing demonstration of the self-contradictory nature of Lamarck's "laws." The author appears to attach far too much importance to the "mutations" of de Vries, and regards as well-established certain conclusions on this head which recent researches have seriously shaken. His objections to the part assigned to selection by Darwin and his followers are singularly feeble, and we are not surprised to find that his knowledge of many of the most important facts bearing on this branch of the subject is imperfect. His account of mimicry, for instance, is quite out of date, and the vast mass of highly significant material that has been accumulated under the influence of Fritz Muller's theory of common warning colours is almost entirely ignored. An error, or rather a series of errors, which unfortunately found their way into Weismann's latest work (as pointed out in NATURE, vol. lxxii., 1905, p. 201), reappears in the coloured plate appended to the present treatise. As these errors remain uncorrected in the English translation of Weismann, and have since been copied into several other publications in Germany and America, it may be well to direct attention to them here in detail.

In the plate referred to (Taf. II.), Fig. 1 represents, not, as stated, the male of *Papilio merope*, but the female of the north-east African form, *P. antinorii*. Figs. 3 and 4 are not "forms of *P. merope* from South Africa," Fig. 3 being the *hippocoon* form of the female of *P. tibullus*, a race of *P. dardanus* which occurs in East Africa from Mombasa to Delagoa Bay, and Fig. 4 representing the female of *P. echerioides*, a species quite distinct from the *dardanus* or *merope* group. The butterfly represented in Fig. 6 is not, as stated, *Amauris niavius* from South Africa (the form usually called *dominicanus*), but belongs to the West African race of the species. Finally, in Fig. 7 is shown, not the Danaine *Amauris echeria*, "the immune model of Fig. 4," but another Papilio, viz. the *cenea* form of *P. dardanus* ♀, the mimic having been here mistaken for its model. These mistakes are the less excusable in that several of the forms in question have been carefully discussed and figured by Prof. Poulton.

The great difficulty to be faced by those who, like the author of the present treatise, seek to minimise the influence of selection, is the universal prevalence of adaptation. We accordingly turned with some interest to the passages in which he gives his own solution of the problem. We must confess to a feeling of disappointment. The author makes no serious effort to grapple with the question; he appears to be satisfied with vague phrases about "extra-personal correlation" which explain nothing, while his dictum—emphasised by spaced type—"Artbildung ist einerseits Vervollkommnung, andererseits Anpassung," when taken with its context, seems to savour of the heresy of orthogenesis. However, he claims for his book that it is only an introduction, not an attempt at explanation, and in both parts of the claim we think he is justified.

F. A. D.

OUR COAL RESOURCES

The Coal Question. By the late W. Stanley Jevons. Edited by A. W. Flux. Third edition. Pp. l+467. (London: Macmillan and Co., Ltd., 1906.) Price 10s. net.

THE first edition of Jevons's lucid and exhaustive work was published in 1865 and the second in 1866, and since that date it has constantly been referred to, but almost always misunderstood. The Royal Commissions of 1866 and 1901 both shared the general misunderstanding. This is certainly surprising in view of the care the author took to make his position clear. He argued that within a century the want of coal would seriously check our material progress if the rate of progress in consumption shown at the time at which he wrote were maintained.

Since Jevons's tragic death in 1882 (NATURE, vol. xxvi., p. 420), no one has pointed out the superiority of his logical method over that of his many critics. It is, therefore, a matter for congratulation that Prof. Flux, of McGill University, who was formerly Stanley Jevons professor in the Owens College, Manchester, has edited a third edition, in which he has wisely preserved the text unaltered so far as might conveniently be done, while making such additions as were necessary to embody the knowledge accumulated in the forty years since its original issue. The most important change in the general situation since then is the development of the coal resources of Germany

In regard to this and other developments, the editor has obtained much help from the reports of the Royal Commission on Coal Supplies, and particularly from Mr Bennett H Brough's report on foreign and colonial coal resources to that Commission This material is ably and attractively dealt with by the editor, who shows that it is probable that the exhaustion of the British deposits will not progress much, if at all, more rapidly in relation to their total contents than will be the case with the German coal, and that the reported coal resources of Canada and Australia suggest the reflection that even though an increasing cost of power in Great Britain involve the decay here of the industries on which our country's preponderance is based, the industrial greatness of the British Empire may not pass away

The first chapter forms practically the author's preface to the first edition, and the subsequent chapters in the new edition deal with the following subjects —opinions of previous writers, the geological aspect of the coal question, the cost of coal mining, the price of coal, British invention, the economy of fuel, supposed substitutes for coal, the natural law of social growth, the growth and migrations of our population, the change and progress of our industry, our consumption of coal, the export and import of coal, the comparative coal resources of different countries, the iron trade, problem of the trading bodies, taxes and the national debt, and concluding reflections The width of economic and erudite information and the patriotic tone of the original work have been well maintained, and the whole has been admirably brought up to date The only trifling matter that has escaped the editor's notice is that in a few cases the titles of some of the authorities cited which changed in the course of time have not been altered Thus, Lord Armstrong appears as Sir William Armstrong, Sir Henry Bessemer as Mr Bessemer, Sir Andrew Ramsay as Prof Ramsay, and Lord Swansea (Sir Henry Hussey Vivian) as Mr Vivian The able editing and the arrangement of the matter, as well as the attractive form in which the book is produced, cannot fail to commend themselves to all who share John Stuart Mill's admiration of the work and of its author

THE RELIGION OF THE MALAYS

The Peninsular Malays I Malay Beliefs By R J Wilkinson Pp 81 (London Luzac and Co, 1906) Price 2s net

VARIOUS classes of students, in addition to the Civil Service cadets for whom it is primarily intended, should read the most excellent pamphlet on "Malay Beliefs" recently written by Mr R J Wilkinson The author is one of the most erudite of students of the Malay language, classical and dialectical, and he has acquired an intimate and sympathetic knowledge of Malay customs and beliefs This little book contains a clear statement of the strange mixture of Mohammedan creeds and practices that obtains in the peninsula As Malay Islamism was mainly introduced from southern India, the Malays are Sunnites like the Moslems of the Deccan, but owing to the predominance of Persian influence in India Shiite "heresies" have crept in, further, in the matter of religious law the Malays are Shafeites Below and penetrating through this imported religion are aboriginal vestiges of paganism, always strongly tinted with magic

Mr Wilkinson has some interesting remarks upon the problem of the relation of magic to religion that is at present exercising the minds of students of comparative religion He says —

"The magician may 'indicate' some person to receive the special attention of spirits of disease, much as a man sets his dogs upon an enemy Sometimes by the use of a waxen or other image, or by the exhibition of a 'sample' such as the parings of a man's nails or the clippings of his hair, the wizard conveys to the world of ghosts a knowledge of the person he wishes them to attack- and the ghosts are ever ready to profit by the hint so kindly given Here the practices of Malay witchcraft come very close to sympathetic Magic—to the view that there is 'a certain physical sympathy between a person and his image'

'It is not wax that I am melting
But the liver, heart and spleen of So-and So'

"Nevertheless there is a marked difference between the animistic magic of the Malays and the 'sympathetic magic' defined in Frazer's 'Golden Bough' and accepted by Mr Skeat as the explanation of the use of waxen images in the Peninsula The following invocation (quoted by Mr Skeat himself) shows the real nature of the practice

'Salutation to thee Oh Prophet! Ruler of the World!
Lo! I am burying the corpse of So-and-So
Do you assist in killing him or making him sick'

"The actions of the sorcerer merely illustrate or indicate to the spirits the exact nature of the service that he expects of them If these performances were really based on a belief in 'a certain physical sympathy between the person and his image' it would be unnecessary to invoke the spirits at all"

Mr Wilkinson gives some good examples of accurate observation but inaccurate inference from the facts Thus people have noticed that man-eating tigers have the great canine teeth almost entirely worn away, and they infer that the loss of the teeth is a punishment for man-eating, and not that the beast is driven by the loss of his weapons to the desperately dangerous expedient of preying upon man Again, they know that venomous snakes have stumpy tails, and assume that the use of the venom causes the tail to drop off The author also gives a suggestive account of the training and methods of the native doctor who has some real knowledge of drugs, diet, fomentations and massage, and a thorough knowledge of the weakness of human nature His dodges perplex or mislead rival practitioners, while they delight his patients with the special attention that he appears to be devoting to their individual needs

It is to be hoped that the author will redeem his promise of issuing other pamphlets on Malay literature, life and customs, government and law, history, and industries

OUR BOOK SHELF

John Dalton By J P Millington Pp xii+225 (London J M Dent and Co, 1906) Price 2s 6d net

THIS volume constitutes the latest addition to the series of "English Men of Science" now in course of publication by Messrs J M Dent and Co, and is a concise and well-written account of the illustrious author of the atomic theory Everything there is to tell about the old Quaker philosopher has already been told in such well-known works as the "Memoirs" of Henry and of Angus Smith, and in the lesser-known biography of Dr Lonsdale, and all that a modern historian can do is to put together, with such literary skill as he can command, the facts of his simple, uneventful life The publication of the "New View of Dalton's Atomic Theory" by Sir Henry Roscoe and Dr Harden, and the criticism which the "New View" has received from Debus, might have afforded an opportunity to Mr Millington for the exercise of his critical acumen, but Mr Millington fails to avail himself of it, the quotation from the "Fundamental Satze der Chemie," published two years before the appearance of the "New View," having little relevance to the matter in dispute between them

Mr Millington's narrative is simple and unaffected in style, befitting the character it seeks to describe It is calculated to give the reader a just and faithful impression of a calm and beautiful life, utterly unworldly, and free from any taint of self-seeking, envy, or greed

It might at first sight be thought there was no room for another book on Dalton, but we cannot have too much of such an example, and certainly no biographical series of "English Men of Science" would be complete which omitted his great and honoured name

Verhandlungen der deutschen zoologischen Gesellschaft, 1906 (Leipzig W Engelmann, 1906) Price 10 marks

THIS volume contains the papers read at the sixteenth annual congress of the society held at Marburg, June 5-7 1906 The number of subjects covered by the papers and "demonstrations" is so great that it is only possible to refer to a few On account of being fully illustrated, special mention must be made of a communication by Prof L Plate on the evolution of species in the Bahama land-shells of the pupa group classed under the title of *Cerion glans* The gradation from a large-sized, heavily-ribbed, and uniformly coloured type to a diminutive one in which the place of ribs is taken by bands of colour is admirably illustrated in the plate

In the second paper illustrated by a plate, Dr F Doflein deals with the fauna and oceanography of the Japanese coast, especially from the point of view of the dispersal of organisms in his opinion continental barriers offer much less serious obstacles to the dispersal of marine organisms than is commonly supposed The zoological distribution of animals also forms the subject of a paper by Dr E Stromer, who discusses the bearing of the recent discoveries of fossil vertebrates in the Tertiaries of Egypt on current theories as to the origin of the modern African fauna

Considerable general interest likewise attaches to a long paper, by Prof Simroth on the fauna of Sardinia, which deals in considerable detail with the origin and relationships of the native breeds of domesticated animals, and brings out some noteworthy points in connection therewith Most of the other papers deal with subjects of interest only to specialists It may be added that methods of modern research form the subject of the opening address to the session by Prof Hertwig, and that at the inaugural meeting Prof Korschelt gave an historical sketch of the rise and progress of the zoological institute of the University of Marburg

Photograms of the Year 1906 Pp 164 (London: Dawbarn and Ward, Ltd, n d,) Price 2s

IN these pages we are introduced to a series of excellent reproductions of typical photographic pictures of the year This has been compiled by the editors and staff of the *Photogram*, and a descriptive article accompanies the series Mr A C R Carter contributes a criticism of the two great photographic exhibitions, namely, the "Salon" and "Royal"

In addition to the above, pictorial photography is dealt with in several other essays by various writers Thus Mr Roland Rood writes about America, Mr Mortimer Lamb about Canada, The year's photography in Spain is dealt with by M Mendez Leon, while "Western Workers in the United States" is the subject of an article by M Fayette I Clute

As this annual is noted chiefly for the reproduction of photographs, and in this issue the standard is excellent, it may be mentioned that the principal illustrations are reproduced by Messrs Carl Hentschel, Ltd, and the printing by Messrs F W S Clark and Co, Ltd, on the "first quality art" paper of Messrs John Dickinson and Co, Ltd

One of the frontispieces is an excellent three-colour picture reproduced and printed by Hentschel-colourtype from negatives by Mr William Gill To those photographers who are mainly concerned with the "pictorial" branch of photography this annual will therefore prove of great interest

Les Nombres positifs Exposé des Théories modernes de l'Arithmétique élémentaire By M Stuyvaert Pp xii+132 (Gand Van Goethem, 1906) Price 3 francs

THIS treatise certainly deserves a trial by school teachers The author realises that there is a great gulf between arithmetic, as usually taught in schools, and the strict logic of the subject, and, at the same time, that it is impossible to teach it with complete rigour to a school class He assumes the commutative law of addition, and then proves the elementary rules in a way which is quite sufficient for school purposes, and does not involve any fallacies which afterwards have to be renounced The treatment of irrationals follows Dedekind, that of fractions is based upon the definition that $a/b=c/d$ if $ad=bc$ Proportion is treated in the way that is usual in France, the section on this subject would require to be expanded and illustrated by the teacher, the same is true of other articles, notably § 13, which is unduly condensed, and where the distinction between algebraic and arithmetical divisibility is rather blurred Many teachers will regret seeing contracted multiplication expounded by Oughtred's rule of reversing the digits of the multiplier The rule for contracted division, though instructive, is needlessly complicated from a practical point of view, and, alas! the rule for arithmetical subtraction is given in its old-fashioned form However, these are minor points, and it is worth while to refer to them only because the book is so attractive in other respects Attention should be drawn to the author's way of considering fractions, which he sketches out in his preface

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

The Treatment of Cancer

IN NATURE of December 20, 1906, I note an article (pp 177–8) on "The Treatment of Cancer" As a scientific investigator, I must dispute the truth of the fact that I have any co-discoverer in this matter of the use of pancreatic ferments in the treatment of malignant growths As, of course, you are well aware, all priority in scientific discovery depends upon publication In the case of the medical man mentioned in the article there has never been any publication of scientific facts, and the reference to the comparative immunity of the small intestine from cancer has a very different scientific explanation from that given in the *British Medical Journal*, 1906, p 715 The real reason is the very small extent of the original piece of gut, out of which, by growth within itself, the mammalian small intestine is developed If the explanation given by this medical man were correct, the cœcum ought to be as immune from cancer as the lower end of the small intestine This gentleman has never claimed to have discovered *a* cure, let alone *the* cure, for cancer What he professes to have found is that the proteolytic ferment, trypsin, and not the diastatic one, amylopsin splits up glycogen This is a very remarkable find to have made! Assuming a miracle to have happened when these unpublished experiments were made, and that trypsin *did* split up glycogen, it may be asked why he and his pharmacist adopted for use as an injection into human patients, from about the end of February last until recently, a decoction containing a small amount of practically pure trypsin, which had no action whatever upon glycogen?

The medical man who made this remarkable find, which will not stand the test of confirmation, himself writes in the pages of the *Medical Press* of December 19, 1906, as follows —"Every medical man must deplore the frequent attempts which are made in the Lay Press to induce the public to believe that a cure for cancer has been discovered" This is clear enough Against it I, a scientific man, now affirm not only that *a* cure has been found, but that my own work and discoveries have revealed *the cure* For the evidences of the truth of this statement I will not refer to various microscopic preparations of tumours after treatment, removed by operation, at a *post mortem*, or sloughed away, for these are the property of physicians in England and America who will themselves publish their cases

Instead, as the space at disposal is limited, I will refer to Prof W J Morton's preliminary report in the New York *Medical Record*, December 8, 1906, to the other cases in course of publication there, and to the brief account of the Naples case of inoperable cancer of the tongue, which I hope to see published shortly in the pages of that medical journal Six months after all treatment ceased the patient is alive, well and free from cancer

This is the sequel of the use of preparations of pancreatic enzymes, scientifically prepared, and employed by such able and distinguished physicians as Cavaliere Guarracino and Prof Manzo The cancer yielded to the chemical test The reagent for this is not, as so many in this country have believed, including certain cancer researchers, a solution of glycerine and water, possibly containing a little trypsin, but it is a potent extract of pancreas-gland, prepared from the fresh gland direct, and containing *all* the enzymes

The writer of an article in the *British Medical Journal* for December 15, 1906, p 1736, who displays a close knowledge of the unpublished work of a research body, states that trypsin is among the substances condemned in the passage cited from the fourth annual report of the Imperial Cancer Research Fund I have not used the term "trypsin treatment," for I agree with Prof Poirier, of the French Cancer Research, that trypsin will destroy cancer, but not cure it The preparations used must be such as those manufactured by Messrs Fairchild Bros and Foster, and they must be employed in the way directed by a scientific investigator If the statement be aimed at the course of treatment advised by me, a scientific man, and, as a chemical trade newspaper says, "not even a medical man," if this be the case, I now direct the attention of the scientific members of the executive of the Imperial Cancer Research Fund to its existence I traverse it completely, and deny that it contains a vestige of truth As I have produced evidences of its falsity, if it refer to the pancreatic treatment, I now call upon these scientific men to substantiate the truth of the point by the production of evidences, including a clear account of the means adopted to obtain a proper injection compound, or to retract and withdraw the assertion, for what happened in Naples has also occurred in New York, as well as in other places in this country, even in the neighbourhood of this city of Edinburgh

J BEARD

8 Barnton Terrace, Edinburgh, December 23, 1906

WITH reference to the above letter questions of priority are not involved in the article referred to It may be that Dr Shaw-Mackenzie's advocacy of the trypsin treatment of cancer was based on a misconception, but that he did independently evolve it seems clear to us, and this is all that was suggested in the article His line of treatment is indicated in a letter to the *British Medical Journal*, May 27, 1905, p 1183, and again in the same journal, January 27, 1906 p 240, in the latter not only trypsin, but pancreatin and secretin are suggested As regards the term "trypsin treatment," Dr Beard, in an article in the *British Medical Journal* (January 20, 1906, p 140), uses the phrases, "the length of time and number of injections of trypsin necessary to destroy the tumour" "trypsin is the substance which will destroy the cancer cell (Beard and Shaw-Mackenzie)," &c , and he moreover states, "the preparation of trypsin employed (Fairchild Bros and Foster's) was that originally dispensed to Dr Shaw-Mackenzie's prescription by Mr F W Gamble," thus acknowledging Dr Shaw-Mackenzie's work, and actually making use of the latter's preparation of trypsin! Accepting the details of the case of cancer of the tongue cured by pancreatic extract as correct, it is a remarkable one, but not unique The writer knows a case of mammary cancer diagnosed as such 4½ years ago by four doctors, and on which a London surgeon refused to operate, which after treatment with X-rays has atrophied, and the patient is well and in good health to-day, surely as remarkable a case! Lastly with regard to the alleged cures of cancer obtained by Prof Morton in America (to which reference was made in the article), these are summarised in the *British Medical Journal*, December 22, 1906, p 1835 About thirty cases were treated, and the results claimed are cure in two cases, remarkable atrophy of the tumour in one, and arrest of disease in many In one case the "cure" has lasted four months, in the other one month! It is absurd yet to speak of such cases as "cured", careful surgeons allow a *three years'* limit! To claim that "the cure" for cancer has been found has at present nothing to substantiate it, and in our opinion Dr Shaw-Mackenzie's position is far more scientific than Dr Beard's We believe that the pancreatic enzymes must be injected into the neighbourhood of the growth or used locally, how, then, could the secondary growths in internal organs &c , be attacked? Until this can be done, no "cure" for cancer will have been obtained

THE WRITER OF THE ARTICLE

The American Gooseberry mildew

I GIVE below the facts concerning the outbreak in England of this disease

This mildew, *Sphaerotheca mors-uvae* (Schwein), Berk —known in America since 1834—has proved so destructive there as practically to prevent the cultivation of the European gooseberry on a commercial scale [1] It was unrecorded in Europe until 1900 when it appeared in a few gardens in the north-east of Ireland It has spread over

1 See, for example, Year Book U S Dept Agric , 1899 also Bull 114 161, N Y Agric Exper Stat

the eastern half of Ireland, causing great damage.[1] The disease has broken out on the Continent, and assumed epidemic proportions, causing such devastation that drastic legislative measures are being employed. The evidence shows that the outbreaks have originated from gooseberry-plants imported from America.[2]

In October last I discovered the disease in an English nursery on standard gooseberries recently imported from the Continent, and later in commercial plantations in one of the chief gooseberry-growing districts of England. I have since been warning fruit growers, by means of lectures and otherwise, of the new danger. I have taken every step to impress on the Board of Agriculture the necessity for preventing further importation of diseased plants and for enforcing the destruction of all those already infected.

The Board, on being informed of the outbreaks, sent Mr. Massee to the infected districts. As the result of his visit, a series of statements throwing doubt on the foreign origin of the disease and its serious nature have been widely circulated in the Press. These, as coming from the mycologist to the Board of Agriculture, have caused many growers to relax, at this critical stage of the first outbreak, their efforts to stamp out the disease.

I am convinced that there is no scientific foundation for the statements referred to. I have suggested[3] that the points at issue should be submitted to arbitration, for it is most important to fruit growers that no doubt should be allowed to remain on a matter which so affects their interests.

The Board has issued a circular warning growers of the serious nature of the disease, but it does not recognise that the disease is new to the country, and that legislation is necessary. Unless the Board takes stronger measures at once, and unless the effect of the statements made by Mr. Massee can in some way be counteracted, nothing can prevent the disease from spreading and causing losses of many thousands of pounds. F. S. SALMON.

South-Eastern Agricultural College, Wye, Kent, January 5.

Filter Presses.

WE shall shortly be compelled to purchase a filter press, and should be glad if you would give us information as to the best firms to approach in this matter.

THE "COOPER RESEARCH LABORATORY."

Water Lane, Watford, January 7.

[MANUFACTURERS of filter presses are invited to put themselves into communication with our correspondent.—ED. NATURE.]

ARCHÆOLOGICAL DISCOVERIES IN TURKESTAN.

WE have referred already (NATURE, December 13, 1906, p. 155, and December 20, 1906, p. 180) to the archæological expeditions of Dr. M. A. Stein and Dr. von Lecoq in Central Asia. News of Dr. Stein's second expedition, which has resulted in further finds of importance, has lately been received, and details of the discoveries of Dr. von Lecoq (foolishly described in a telegram from India as comparable with those of Layard and Rawlinson!) have been communicated by the discoverer to the Srinagar correspondent of the *Times of India*, quoted in the *Times* of January 3. From these it is evident that Dr. von Lecoq's discoveries are, as might have been expected, analogous to those of his forerunner, Dr. Stein, in imitation and emulation of whose work the Prussian expedition of Dr. von Lecoq was sent out. The MSS. documents found by Dr. von Lecoq are, with the exceptions noted below, of the same type and in the same languages as those found by Dr. Stein, and, further, Buddhist paintings of the kind described by Dr. Lecoq as "the missing stepping-stone by which Indian art advanced across Asia to Japan" were first found by Dr. Stein.

This being said, however, we must note that Dr. von Lecoq's work was carried out in a different part of Turkestan from Dr. Stein's, in the vicinity of Turfan and Urumchi, as well as at Kucha and Kurla. It is therefore to be expected that the results of the Prussian expedition, while generally analogous to those of the Indian ones, will show peculiarities due to difference of geographical position, &c., and it may well be that Dr. von Lecoq has discovered objects of later date than any found by Dr. Stein. The documents which he has found are mostly of the same kind and in the same tongues as those found by Dr. Stein, but some are written in new, or rather little-known, languages, such as Tangut, Koh-Turki, Middle Persian written in the Manichæan alphabet, and a sort of Central Asian dialect of Syriac. Manuscripts in ordinary Syriac were found; these are, of course, monuments of the Christianising activity of the Nestorians in Central Asia from 600 A.D. to 1000 A.D. A curious discovery is thus described:—"The furious zeal of the Chinese conquerors of Turkestan against Buddhism was exemplified by the discovery of the packed bodies, still clad and odorous, of a multitude of Buddhist monks driven into a temple, and stifled there, more than a thousand years ago."

Dr. von Lecoq's colleague, Prof. Grunwedel, is still working in Turkestan. Already fifteen chests of MSS., and altogether about 200 cases of "finds," have been sent to Berlin. "The expedition up to date has cost the German Government 10,000*l.*, a sum which may be contrasted with the 800*l.* spent on Dr. Stein's epoch-marking expedition of 1900–1 by the Indian Government." Comment upon this fact is superfluous, and would in any case be useless.

The current number of the *Geographical Journal* contains a letter from Dr. Stein, dated from Keriya on October 10, 1906, giving an account of his work up to date. Apart from his trigonometrical surveys of the Kuen-lun mountains and his archæological re-examination of the Buddhist monument known as the Rawak Stupa (already mentioned in NATURE), Dr. Stein excavated a small ruined temple in "the extensive débris-strewn areas known collectively as the Tati of Hanguya." Here he found terra-cotta rilievos of the fifth to sixth century A.D., often covered with rich gilding. Dr. von Lecoq reports similar discoveries of gilt paintings. East of the Khotan oasis Dr. Stein excavated ruined shrines near the village-tract of Domoko, that of Khadalik yielded MSS. of the same date as those discovered by Dr. Stein previously at Dandan-Uiliq. In one were found stringed rolls of Chinese copper money, deposited by one of the last devotees before the storm of Tibetan conquest wrested the land from the Chinese. At the time of writing, Dr. Stein was proceeding from Keriya to the eastern sites beyond Niya.

AT THE BACK OF THE BLACK MAN'S MIND.[1]

THERE can be no question as to the originality and value of this book as a contribution to West African ethnology. Mr. Dennett has lived many years amongst the Bavili and other tribes of the Kakongo district (Luango coast) immediately north of the Congo mouth. He has also of late lived as an official several years in the Benin district of the Niger Delta. About three-quarters of the book under

[1] Journ. Roy. Hort. Soc., vols. xxv.–vii., xxix. (1900–6).
[2] See Eriksson, *Zeitschr. f. Pflanzenkrankh.* Bd. xvi., also work of de Jaczewski.
[3] The *Times*, December 28, 1906.

[1] "At the Back of the Black Man's Mind; or, Notes on the Kingly Office in West Africa." By R. E. Dennett. Pp. xv+288. (London: Macmillan and Co., Ltd., 1906.) Price 10s. net.

review deals with the hierarchy of kings and chiefs, the laws, social organisation, marriage, birth, and death customs, psychology and philosophy of the Bavili; the remainder of the book treats with much the same subjects as they have been observed by the author in Benin. Finally there is a valuable appendix by Bishop James Johnson on the religious beliefs and social laws of the Yoruba people.

To anyone interested in the Bantu languages or in the social organisation of the Bantu peoples Mr. Dennett's book will be of great importance. He reveals to us the existence of a relatively ancient (though perhaps not so ancient as he imagines) semi-civilisation of these Luango people. It is remarkable how much their ideas regarding their royal families, their kings and chiefs, resemble the customs of Uganda or of the Mwato Yanvo empire in south-central Congoland. There are also similar ideas of totemism or the division of society into cliques and coteries, each with its emblem or ancestral crest, such as the large Cephalophus antelope, the chimpanzee, pig, otter, francolin (which Mr. Dennett miscalls "partridge"), and domestic goat. Though Mr. Dennett does not cite the mushroom as a totem, it appears to be regarded as possessing mystic qualities (as in Uganda). He gives a native equivalent for "totem" as "china" (which he mis-spells *xina*), plural "bina." This word he also renders as "prohibition." It is apparently related to the widespread Bantu root *kina* or *bina*, to dance, such dancing being of a ceremonious or religious nature, and often used to illustrate the action or the object which should be avoided by the persons concerned.

It is also interesting to notice that the word for sacred grove or specially preserved forest in Luango is the same as in the languages of the Victoria Nyanza, *chi-bila*, *bi-bila* (in East Africa this word is pronounced *-bira*).

Mr. Dennett deals exhaustively with the omens of birds, frogs, dogs, and snakes, also the remarkable connection of the rainbow and its primary colours with certain specified serpents supposed to represent each colour. He describes all the sacred animals (and the folk-lore concerning them), also the names of the four days of the week (for, as in most parts of negro Africa, the week contains only four days), the names of the seasons, native ideas of astronomy and natural history (the details about the life of the chimpanzee are particularly interesting).

Somewhat similar information is given about Benin. Both in regard to the Bantu people of Kakongo and the West African negroes of Benin Mr. Dennett supports his opinion by citations of the native languages, which (overlooking an exasperating orthography) are almost invariably correct. In some cases he does not seem quite to have grasped the meaning of words. For example, *Nzambi mpungu* really means the God of the Firmament, though this is not quite clearly stated by Mr. Dennett, who has not realised that *mpungu* is only a variation of the East African Bantu *mwingu*, from a root (probably originally *-pingu*) meaning the sky, the heavens, the region in which rain falls from the clouds.

The reviewer cannot accept Mr. Dennett's etymology of the Bantu phrases he attempts to explain. He would read into them a philosophy which is altogether misleading. An acquaintance with other and cognate forms of speech would have shown him this.

For the mass of the book, however, the reviewer has nothing but praise, but he must enter here an emphatic protest against the unreasonable orthography adopted in the case of the Luango or Kakongo language (but not as regards the Bini tongue). For the consonant *c* or *ch* (the sound of *ch* in *church*) Mr. Dennett uses the letter *x*. Most transcribers of African tongues have agreed to adopt the single letter *c* to express the combination *tsh* or the palatal *k*. Some missionary writers have made use of the letter *x* in its Portuguese interpretation for the sibilant *sh*. It is a great pity that even this should be done, for if *x* is to be used at all it might preferably be employed to express the combination *kh*, the guttural *ch*, but to transfer this needlessly for *c* or *ch* is a serious stumbling-block to the reader. There are

Mavunga, a Kabenda nail fetish. From "At the Back of the Black Man's Mind."

other points (which it would be wearisome to discuss in detail as regards the transliteration of these Bantu dialects in Mr. Dennett's book) that hinder and confuse. It is such a valuable contribution to ethnology that one could almost wish a second edition might be brought out with a revised and reasonable orthography—from which, for example, such blots as "Fjort" might be removed. This is the way in which Mr. Dennett for many years past has chosen to spell the Congo word *fi-ote*, which means "a black man."

JUJUTSU [1]

THIS work gives most clearly and concisely an idea of the fascinating art of jujutsu. It is written with the idea that anyone having had a few lessons may continue the exercises, or throws, without the constant help of a teacher, though to learn from the description only would be quite impossible.

Sir Lauder Brunton has given an admirable preface, from which it may be inferred that the medical profession thinks highly of jujutsu as a matter of exercise for both sexes. He says:—"By it not only is every muscle strengthened, but the highest centres of the brain are developed, those whose functions are perception, discrimination and decision."

Japanese wrestling, or jujutsu, differs entirely from the English form of wrestling, which is more or less a trial of strength. In jujutsu it is a question of quickness and brains; the throws are given by taking advantage of the opponent's movements, so that as the attacker advances the opponent trips him up, or gives the throw, by profiting by the momentum of the attacker's body, placing his foot, leg, or arm in such a position that the attacker cannot save himself from falling. In fact, the momentum of the attacker is used to his own detriment.

FIG. 1.—First position of the Uchimata, showing the lifting pull of the thrower's right hand. From "The Fine Art of Jujutsu."

In commencing, the pupil learns to give the "Laudori Kata," which form the basis of nearly fifty methods of defence against various attacks, and not until the pupil has had many lessons is he or she allowed to learn how to take a fall. There is as much to learn in taking the falls as in giving them, and, provided he follows the teacher's instructions exactly, he need not be afraid of getting hurt.

After several of the throws have been separately mastered the pupil is taught to put them in practice in the "loose play," and here it is that the real delight of jujutsu commences, for all his faculties must be alert; he may trip up his teacher with an ankle throw, or, taking advantage of some side movement, may give the "Hizagurama" or trip from the side of the knee, or he may turn sharply round and give the shoulder throw, bringing his opponent over his shoulder on to the ground. Then, when well advanced, the pupil takes his chances against his teacher, and the struggle to put in a throw on either side becomes very exciting.

One great delight of these exercises, as mentioned in the preface, is the extreme accuracy which is absolutely necessary; if a certain movement is not done correctly it cannot be done at all. If the opponent fails to take advantage of the movement of the attacker at the right instant it is impossible by main force to effect a throw.

Perhaps the most difficult throws are those given in Figs. 44 and 45, which are here reproduced, called the "Uchimata," for it requires immense practice to get the balance necessary to gain the second position.

Besides the throws, there are many locks which are most effective in overcoming an opponent. Fig. 111 and the following series represents one of these in detail, by which, when used in self-defence, it is not difficult to break the elbow of the attacker.

In addition to the jujutsu described in these pages

FIG. 2.—Second position of the Uchimata, showing the full fling up of the thrower's right leg while standing poised on the left. (From "The Fine Art of Jujutsu.")

there is another form, which consists in wrestling on the ground, where the throws are given and are finished by a lock on the ground, but this is such a very rough form of exercise that it is not described in Mrs. Watts's book.

We have not yet alluded to the excellent illustrations by that well-known amateur photographer Mr. G. W. Beldam. Without them the text would be impossible to follow, and to have caught the different positions so exactly shows immense patience and ability on his part.

T. MARY LOCKYER.

SCIENTIFIC WORK IN EGYPT.[1]

THE work of the Survey Department in Egypt embraces many inquiries outside those usually identified with geodetic measurement. The department is responsible for the conduct of a laboratory in which analyses of rocks, ores, and minerals are made for the Geological Survey, where the illuminating

[1] "The Fine Art of Jujutsu." By Mrs. Roger Watts, with 141 Action Photographs by G. W. Beldam. Pp. viii+146. (London: W. Heinemann, 1906.) Price 6s. net.

[1] "A Report on the Work of the Survey Department in 1905." By Capt. H. G. Lyons, F.R.S., Director General. [illegible] 6+plates. (Cairo: Al Mokattam Printing Office, 1906.)

power of the Cairo gas is determined, and where paint, oils, cement, asphalt, &c., are tested for commercial purposes. Further, the purity of the water supply of Cairo demands constant attention, while the river water and the silt which the Nile carries in suspension during a large portion of the year have to be repeatedly examined. These are matters which must be passed over with a bare mention, though doubtless the management finds the addition of such investigations sufficiently exacting.

More immediately connected with the work of the department appear to be the hydrographic survey of the Nile and river gauging. For the efficient examination of questions connected with this subject a permanent gauging station has been erected at Sarras, thirty-three miles below Wady Halfa, and here are measured in various ways some of the factors that determine the quantity of water in the river. The work is hardly out of the experimental stage at present. A main object is to determine the most appropriate kind of apparatus that will give accurate results with the least expenditure of labour. This section is very interesting, and tables are added showing the volume of water discharged in cubic metres per second, and the mean velocity per second, with other details. The velocity and volume both increase up to the end of August, when, unfortunately, observations were discontinued, though the time of maximum was not reached. A preliminary discussion of the results has shown that the volume of the discharge at Khartoum, when the Atbara was not contributing, was greater than that at Aswan by amounts which could not be explained by loss from evaporation or from use in irrigation. The cause of the loss is not yet decisively explained, though Captain Lyons makes a plausible suggestion.

Another feature of the report is the description of the Helwan Observatory, which seems to be very fairly equipped with magnetic, meteorological, and seismological instruments. Of the astronomical portion, we learn that the 30-inch reflector presented to the Egyptian Government by Mr. R. H. Reynolds, of Birmingham, is in course of erection, and that all the heavy castings are in position. Some of the mechanism has been returned to England for alteration, and the completion of the erection awaits the return of these essential fittings.

Of the geodetic work properly so-called, details are given of the second order triangulation with all necessary fulness. The standard of accuracy attained is not quite that of the highest order, but sufficient for the object for which the measurement was undertaken, namely, the control of the map sheets used in the revenue survey of the country. It is now possible to base a map of Egypt on a connected triangulation from Damietta to Wady Halfa, an extent of nine degrees. Of even greater importance, however, is the triangulation, which it is to be hoped will be ultimately carried out, whereby Egypt will contribute to the measurement of the arc of meridian, which in its entirety will extend from the Cape of Good Hope to the North Cape, along the thirtieth parallel of east longitude. For several years Sir David Gill has been engaged in carrying this chain of triangulation northward, and the prospect of completing a measured arc of some 100° of latitude cannot but be of profound interest to the astronomer, the geologist, and the physicist. Captain Lyons, however, is fully aware that the value of such a work consists very greatly in the maintenance of the same standard of accuracy throughout. The most difficult problem of geodesy, he tells us, is to pass from a particular platinum and iridium bar, on which the length of the metre is defined, to the length of a base line over a more or less rough land surface with as great an accuracy as possible. Viewed in this light, the most interesting portion of the report consists in the description of the method of the comparison of the bars and Jaederin wires used in Egypt. The accuracy seems quite satisfactory.

W. E. P.

INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE results of the first two or three years of active investigation in connection with the general scheme of fishery research, which is being carried out in the seas around north Europe under the auspices of the International Council for the Exploration of the Sea, are now being rapidly published in a series of reports issued in part by the Bureau of the International Council and in part by the authorities of the different countries participating in the international scheme. As the outcome of the work is being thus gradually brought to light, the comprehensive character of the programme becomes increasingly obvious. The remarkable scientific interest of the results obtained from what is probably the greatest and most serious attempt yet made to carry out a scientific investigation by means of international cooperation is placed beyond dispute, nor can it be doubted that the eventual practical benefit of these researches will be of even more importance and of much direct value to the fishing industry.

The first report under review contains detailed accounts of some of the work carried out in 1902 and 1903, whilst in the Marine Biological Journal Mr. James Johnstone, of the Liverpool University Fisheries Laboratory, gives a useful *résumé* of the results published up to the summer of 1906. The remaining reports deal for the most part with more recent publications.

As must be by this time well known, three main lines of research are being developed in the international scheme, the hydrographical, the biological, and the statistical. The hydrographical investigations record and endeavour to explain the constantly changing physical conditions under which fishes pass their lives, the biological investigations aim at a complete account of the life-history of the more important food fishes as well as a detailed knowledge of the various smaller marine creatures which serve as the food of fishes, the statistical investigations deal primarily with the variations in the actual quantities of fish removed from the different fishing-grounds and brought to market, and at the same time yield considerable material which is capable of supplementing and amplifying the knowledge of the history of the fishes obtained from the biological observations. Although the three branches of the investigation are for practical reasons carried out more or less independently, the ultimate success of the work depends upon the judicious combination of the knowledge gained from each, and its application to particular problems of the fishing industry.

A striking example of the success of such a combin-

[1] Reports of the British Delegates attending the Meetings of the International Council for the Exploration of the Sea in 1903, 1904 and 1905, and Reports and Correspondence relating Thereto. Vol. ii. General Report of the International Council for 1902–1904. [Cd. 3033.] A Reprint of Conseil permanent International pour l'Exploration de la Mer. Rapports et Procès Verbaux, vol. iii. (London: Printed for H.M. Stationery Office.)

Conseil permanent international pour l'Exploration de la Mer. Rapports et Procès Verbaux, vols. v. and vi.; Bulletin trimestriel des Résultats acquis pendant les Croisières périodiques et dans les Périodes intermédiaires, Année 1905–1906, No. 3, Janvier–Mars, 1906. Bulletin statistique des Pêches maritimes des Pays du Nord de l'Europe, vol. i., pour les Années 1903 et 1904.

Journal of the Marine Biological Association of the United Kingdom, vol. vii., No. 5.

ation is contained in Dr Johansen's paper on the plaice fishery of the Kattegat, and the means whereby it may be improved (*Rapports et Procès-Verbaux*, vol v, p 45) From a study of statistical data it is shown that although the intensity of fishing for plaice in the Kattegat, in consequence both of an increase in the number of boats and of improvements in the fishing gear, has increased very greatly since 1885, the actual weight of plaice landed has remained practically stationary from that year until 1904, the year for which the last statistics are available It is only a rise of about 200 per cent in the price of plaice that has enabled so many boats to continue profitable fishing, but although the total weight of fish has neither increased nor decreased during the period mentioned, there has been a marked decrease in the average weight per fish so that the plaice harvest is now composed of a much larger number of smaller fishes than was formerly the case Johansen, following out an idea previously developed by Petersen, shows that at the present time by far the greater number of plaice are captured before they have attained the size at which their value per unit of weight is greatest

Biological investigations carried out in the Kattegat have shown that there are important differences between the plaice populations in the northern and in the southern parts of the area In the northern Kattegat the fish are large and well grown, and attain sexual maturity at a later age and larger size than those in the southern Kattegat This change in the character of the fish population is correlated with the changes in the hydrographical conditions which take place as the Baltic is approached The plaice supply of the southern Kattegat consists chiefly of small fish already sexually mature, that of the northern Kattegat of larger and more valuable fish which have not yet attained maturity

The principal nurseries for young plaice near the Danish coast have been investigated, and the fact that the rate of growth of the fishes on some of these nurseries as determined both by marking experiments and by examination of otoliths, is abnormally low suggests that these particular grounds are overcrowded with young fish This condition is not, however, found in either the Kattegat or Skagerak, and in the southern Kattegat the rate of growth during the first two or three years of the life of the plaice is as rapid as in the northern part, although in later years it becomes much less rapid The experiments with marked fishes which have been carried out on plaice in the Kattegat have shown that far more than 50 per cent of the plaice are re-captured each year, thus indicating a very high intensity of fishing

After a careful review of the evidence gathered from all the different lines of research, Johansen comes to the conclusion that the enforcement of a minimum size-limit for Kattegat plaice of 30 cm (12 inches) would result in an increase in the value of the fishery amounting to from 50 per cent to 100 per cent, although the exact figure can only be determined by experiment Further, since in certain parts of the Kattegat only insignificant numbers of small plaice are found but these grow rapidly, he thinks that the transplantation of large numbers of small fish from more crowded nursery grounds to such places would be worth a trial

A study of Johansen's paper can hardly fail to leave the impression that a great advance has been made towards the solution of the more important problems connected with the plaice fishery of the Kattegat, and that promising practical schemes, based upon a rational understanding of the questions involved, are already in prospect for the improvement of that fishery The Kattegat is a somewhat circumscribed sea-area of moderate dimensions, and it will be scarcely surprising if the end to which all scientific fishery investigations are directed is first achieved there, but the reports before us show that work upon quite similar lines is being rapidly done on the plaice fisheries of the larger region, which may be described as the middle and southern North Sea The summary of the investigations of the German, Dutch, and English naturalists, which is contained in the report of Dr Garstang, the convener of Committee B ("Reports of British Delegates," vol ii, p 191), in that of Dr Redeke (*ibid*, p 265), and in the various statistical papers by Henking (*ibid*, p 127), Hoek (*ibid*, p 300), and Kyle (*ibid*, p 363, and especially *Bulletin statistique*, vol i), foreshadow as complete and satisfactory a solution of the problems in this area as has been, one might almost say, already achieved in the Kattegat

In the larger area the marked-fish experiments have already yielded much valuable information, and it ought not to be long before a fairly complete account is available of the normal migrations of the plaice The transplantation of small plaice from the crowded nursery grounds along the coast to the shallow waters of the Dogger Bank, in the middle of the North Sea, has been attended with a high measure of success, the growth of the transplanted fish having been several times greater on the Dogger than on the inshore grounds An experiment in transplantation upon a very much larger scale is the next step which appears to be called for

The plaice, however, is only one amongst the many fishes which have received attention Much interesting work has been done on the haddock and on the cod, although most of the reports so far published are of a preliminary character only (Hjort and Petersen "Reports of British Delegates," vol ii, p 153)

The herring, too, is receiving attention, and the statistical data brought together by Kyle (*Bulletin statistique*, vol i, p 228), with the accompanying charts give a graphic picture of the movements of the herring fleets, and therefore, presumably, of the fish themselves The attempt already begun to correlate these movements with changes in the hydrographical conditions will almost certainly yield valuable guidance to the herring fishermen, and ought to enable them to avoid much fruitless shooting of their nets

A striking piece of work is Dr Johs Schmidt's contribution to our knowledge of the life-history of the common eel (*Rap et Proc -Verb*, vol v, p 137) Grassi and Calandruccio had already followed, from specimens taken in the Straits of Messina, the different stages in the metamorphosis of the eel larva from *Leptocephalus brevirostris* to the young elver, and they had suspected that the natural home of the Leptocephali was in deep water, their occurrence in the Straits of Messina being due to the peculiar nature of the currents and the upwelling of water from the deeps Schmidt's researches, carried out on the Danish investigation steamer *Thor*, to some extent confirm this view, rendering it at the same time more precise, and the spawning grounds of the European eel and the home of the eel larvæ are now for the first time made clear It is along the edge of the continental slope, to the west of the British Isles, that the young eel larvæ (*Leptocephalus brevirostris*) are found in large numbers, in regions where the depth of the water is about 500 fathoms and the bottom temperature is at least as high as 7° C The larvæ themselves are not, however, near the bottom,

but occur chiefly in the upper and middle water layers, being found during the daytime in greatest numbers about 50 fathoms below the surface. The inference is obvious that the female eels spawn on the bottom in the same or a neighbouring area to that in which the larvæ are taken. The highest point of larval development seems to occur in June, the Leptocephalus has then ceased to feed, and the next stage of its existence is a long, retrogressive metamorphosis, during which it decreases in size in all dimensions, and gradually takes on the slender eel-like form. During the latter part of the metamorphosis the larvæ, or elvers as they may now be called, become very active, and commence their great migration towards the coast and the fresh waters in which they feed and grow. The whole process of metamorphosis occupies about a year, and during this time the young eels take no food at all.

Schmidt has obtained information from localities all along the west coast of Europe, from Spain to Norway, as to the time of year when the young elvers first appear in the rivers, and the interesting fact comes out that the time of occurrence of the elvers on the different coasts depends, in the first place, on the distance from the deep water in the Atlantic where the eels spawn. On the coasts directly washed by the ocean the ascent into fresh water begins between September and December, or even in January or February, according to the distance from the deep water, whilst on the coast of Denmark and in the inner Danish waters the elvers do not arrive until April and May.

The whole story of the life of the common eel, as now made clear by these investigations, is one of the most fascinating which it has fallen to the lot of any naturalist to unravel. We can picture the great shoal of parent eels, the long journey from the inland waters ended, arriving at their proper spawning places in the deep Atlantic along the whole length of the European coast, the floating eggs gradually developing into transparent, deep ribbon-shaped Leptocephali, the slow transformation to slender, active elvers, the vast multitude of elvers, foodless, their whole energy concentrated and spent in locomotion only, moving steadily in towards the coast, entering the rivers of Ireland and of France, entrapped in the great funnel of the Severn's mouth, pressing on through the English Channel and into the North Sea, a remnant only, when tribute has been paid to all the rivers by the way, reaching the fresh waters of Denmark and the Baltic coasts, and, finally, the feeding and growth of the eels all over the European continent in preparation for the return migration to the sea.

There can be little doubt that this new knowledge of the life-history of the eel will lead to results of great practical value to the eel fisheries of Denmark. The fact that one large market for Danish eels is in London makes the question one of practical interest to this country also. In the first place Schmidt points out that since Denmark and the Baltic depend for their supply of young eels upon the general European stock coming from the Atlantic, any protection of the adult fish in Danish waters is quite uncalled for, since even if all the Danish and Baltic eels were caught, only an insignificant reduction in the number of eel larvæ in the deep waters of the Atlantic would result. In the second place, since the evidence seems to show that the main supply of young eels to the Baltic comes from elvers which have travelled through the English Channel, and not around the north of Scotland, only a remnant of the great shoal of migrating elvers reaches that coast, a view which is confirmed by the fact that in Danish rivers no such immense runs of elvers are known as are found in the Severn or in the rivers along the Atlantic sea-board. It would seem that whilst the latter rivers, owing to their geographical position and configuration, receive far more elvers than they are able to support, those of Denmark and the Baltic may have a deficient supply. Schmidt recommends, therefore, that elvers should be taken from the western rivers (elvers caught in large quantities in the Severn are sold at from 1d. to 2d. per pound, and one pound contains about 1500 individuals) and transferred to the Danish rivers and to the Baltic, where they are wanted, and where there is room for them to grow into large eels.

Lack of space precludes us from describing in the same detail as we have done for the plaice and the eel the work which is in progress in connection with the other food-fishes. Heincke's report on the occurrence and distribution of the eggs, larvæ, and various age-groups of the food fishes in the North Sea (*Rapports et Procès-Verbaux*, vol. iii.) and the papers by Hjort and others on the life history of the haddock and cod already referred to clearly indicate results which may eventually be of even greater interest and importance than those described above.

It seems impossible, after an impartial consideration of the volumes before us, to come to any other conclusion than that the International Fishery Investigations are being conducted with marked energy and enthusiasm by all the countries engaging in them, and that the great conception of an international cooperation of men of science having for its object the acquirement of the knowledge necessary for the rational exploitation of the sea on a scientific basis is in a fair way to justify itself in the eyes of the world.

NOTES

On Monday last the Duke of the Abruzzi delivered to a large audience in the Argentine Theatre at Rome a lecture on his expedition to Ruwenzori, and was awarded the gold medal of the Geographical Society of Italy. The King and Queen of Italy were present with their full Court, and the Diplomatic Corps and chief officers of State also attended. The lecture will be repeated at a special meeting of the Royal Geographical Society to be held at the Queen's Hall, Langham Place, on Saturday, when the King and the Prince of Wales have signified their intention to be present.

We regret to announce that Mr. Cornelius O'Sullivan, F.R.S., known chiefly by his investigations on scientific aspects of brewing, died on January 8, in his sixty-sixth year. We regret also to learn of the death of Mr. T. R. Dallmeyer, head of the famous optical firm, and formerly president of the Royal Photographic Society.

Major F. H. Hills, C.M.G., R.E., who has been appointed to inspect and report upon the survey departments now working in the protectorates of British East Africa and Uganda, has just left England for Mombasa. On the completion of the above-mentioned work he will proceed to Colombo to make a similar inspection in Ceylon.

A new Government farm, to be devoted wholly to tobacco research, is to be opened, says the *Pioneer Mail*, in the Rangpur district of Bengal, which is believed to contain perhaps the most important tobacco-growing area in the whole of India, the climate and soil in certain parts of the district being admirably suited to the cultivation of the crop.

SOLAR halos are not so rare as to be very remarkable meteorological phenomena, but a halo seen complete or in parts in the afternoon of January 4, in various parts of the country, seems to have excited some interest among people unfamiliar with its nature At Hitchin the halo was first noticed about 2 15, and it lasted until about 3 o'clock, three-quarters of a complete circle being visible A complete halo was noticed at Southampton and Worcester about 3 o'clock, and portions were observed near Ealing at 3 20, and at Chichester about 4 o'clock

ON Tuesday next, January 15, Prof Percy Gardner will deliver the first of two lectures at the Royal Institution on "The Sculpture of Aegina in Relation to Recent Discovery," and on Thursday, January 17, Dr W N Shaw will begin a course of two lectures on "Recent Advances in the Exploration of the Atmosphere" The discourse on January 18 will be delivered by Sir Andrew Noble, Bart, K C B, on "Fifty Years of Explosives" Prof W W Watts being unable to deliver his two lectures on the "Building of Britain" and "Recent Light on Ancient Physiographies" on Thursdays, February 14 and 21, Mr Alfred Harker will deliver two lectures on those dates on "The Minute Structures of Igneous Rocks and their Significance"

A MAGNETIC survey of Mexico is now in progress under the joint auspices of the Mexican Government and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington It is reported in *Science* that the Mexican Government has two parties in the field under the direction of the Observatorio Astronomico Nacional Mexicano one having charge of the eastern part of the country and one of the western part, embracing the Pacific coast from Manzanillo to Guaymas, inclusive of Lower California The Carnegie Institution party will confine operations to the part of Mexico north of the twenty-fifth parallel upon the completion of which it will proceed to Campeche, Yucatan, and the Central American countries It will be possible within the next year to construct accurate magnetic maps for the region between the parallels of latitude 20° and 49° north and meridians of longitude 65° and 125° west of Greenwich

THE Harvard ethnological expedition to South America is now on its way to Arequipa, Peru, where it will make its headquarters for three years It consists of Dr W C Farabee a Harvard instructor in anthropology, with two assistants Mr I J de Milhau and Mr J W Hastings, with Dr Edward F Horr as physician to the party Its main object is to collect all possible information about the little-known Indian tribes living on the headwaters of the Amazon and Parana on the east of the Andes The only previous exploration in this region was that of Dr Flick, a German man of science, who, however, covered only a small part of the territory that will now be visited The expenses of the expedition will be met by a recent Harvard graduate The Secretary of State has provided letters of introduction to various officials in South America, and assistance is also expected from the Harvard Observatory at Arequipa Another scientific expedition in which Harvard is interested is that which Prof Alexander Agassiz is projecting for February, when he will take a small party in a steam yacht for a cruise in the West Indies

THE University of Michigan has come into possession of a tract of land which is to be developed into a garden meeting all the requirements of the present-day European botanic gardens We learn from *Science* that the ground comprises about thirty acres, and is separated from the Huron River by an approximately equal area owned by the city of Ann Arbor By an agreement entered into by the University and the council of the city, the two pieces of land are to be developed as one, thus ensuring a garden and park of at least sixty acres The following four aims for its use will be observed in the development of the garden —(1) teaching, in which students are instructed in the various orders and functions of plants, (2) scientific, in which genetic relationship is studied and experimental work is carried on, (3) economic, in which collections of medicinal and economic plants are made, and the effect of horticulture and agriculture is shown, and (4) æsthetic and popularly educational, in which special provision is made to make the plantings, the drives, and walks of interest and value to the public

AN obituary notice of Prof Ernesto Cesàro is contributed by Prof Ernesto Pascal to part xvii of the current number of the *Rendiconti* of the Lombardy Institution Cesàro was born at Naples on March 12, 1859, and went to study in the School of Mines at Liége, where his brother had previously been appointed professor of mineralogy He soon developed a taste for mathematics, and began to publish papers in *Mathesis* and elsewhere In 1886 he presented more than a hundred papers in competition for university prizes at Messina on infinitesimal calculus, and at Naples on complementary algebra, and six years later, in awarding him the gold medal of the Italian "XL" Society, Beltrami alluded to about 200 papers, many of considerable length from his pen Cesàro returned from Belgium to study mathematics at Rome, but never consented to present himself for examination for the university degree In 1886 he was appointed professor at Palermo, and was awarded an honorary degree by the University of Rome at the early age of twenty-seven In 1891 he was transferred to Naples His works deal with arithmetic, theory of functions, algebraic analysis, theory of elasticity, intrinsic geometry and infinitesimal calculus On September 12, 1906, he was bathing with his son at Torre Annunziata when a wave struck the boy In attempting to rescue him the father was struck on the head, and both father and son perished together

WE have received a copy of an address delivered by Prof Carl Rabl director of the Anatomical Institute at Leipzig, before the university of that city on June 21 1906, and entitled "Uber 'Organbildene Substanzen' und ihre Bedeutung fur die Vererbung" (published at Leipzig) One of the chief subjects discussed is the theory of the continuity of the chromosomes, that is to say, of the chromatic elements of the nucleus of the germ-cell In conclusion, it is argued that the development of an organism must be regarded as a continuous chain of chemical progression, based upon and regulated by a definite anatomical substratum

THE report of the Bristol Museum and Art Gallery for 1906 chronicles the results of the first complete year's working of the combined institutions, and it is satisfactory to learn that in every respect the authorities have reason to congratulate themselves on their efforts The public has responded in an almost surprising manner to the attractions offered, the attendance during the year having exceeded half a million In the natural history section groups of birds, both British and foreign, as well as one of tigers, have been set up for the museum by Rowland Ward, Ltd, and have proved highly attractive In the list of big-game trophies the name of one animal is given as the "Burmese buffalo or gaur," which leaves

the reader in a happy state of ignorance as to the species really referred to

The whole of the second part of vol vii of the Bulletin of the Tokyo College of Agriculture is devoted to silk-worm culture and problems connected therewith, all three articles being from the pen of Mr K Toyama Breeders, it appears, have a belief that if a male moth is mated with more than one female, the product of the later unions will be feeble The author finds, however, that polygamy is a normal condition of the species, and that the reputed ill-effects of this habit are non-existent The study of a fly parasitic on silk-worms forms the subject of the second article In the third, the conformity or otherwise of hybrid silk-worms to the Mendelian law is discussed Careful investigation has shown that, as regards the colour of the cocoons and eggs and the nature of the larval markings, Mendel's law is followed, although in respect to the shape of the cocoons and the brood-characters no adherence to this can be detected

In the twentieth annual report of the Liverpool Marine Biological Committee, or in other words, the Marine Biological Station at Port Erin (Isle of Man) reference is made by Prof Herdman to the urgent need of a steam-yacht for local collecting For two months such a vessel was privately chartered, and employed in experimenting on the kinds of nets best suited for collecting micro-organisms, but, unfortunately the funds at the disposal of the committee do not permit the permanent engagement of a steamer The aquarium continues to form a great attraction to visitors, of whom more than 15 000 were recorded during the summer Several invertebrates new to the fauna of the Irish Sea have been collected The suitability to their purpose of the tanks is demonstrated by the fact that several organisms have made their appearance spontaneously, having gained entrance by way of the supply-pipes, some of which were blocked by the invasion Care has to be taken in regard to placing animals together as one rare anemone was devoured by a commoner kind, while it was found that the worm Nereis is in the habit of dragging Sabellæ from their tubes The fact that the lugworm can swim is a new discovery Prof Herdman's address on "Some Problems of the Sea," referred to in our issue of last week, forms an appendix to the report

In the January issue of the *Century Magazine* Prof H F Osborn describes a find of prehistoric crania from a mound in Douglass County, Nebraska Of the six skulls discovered, two from an interment near the surface of the mound were of the modern Indian type, but beneath these, and covered by a layer of ashes resting on a stratum of silt compacted by the fire above, four skulls of a remarkable character were unearthed The only implement found with them was a small, broken, triangular flint knife Unfortunately, the back part of each of these crania is wanting, but the portions which remain exhibit low cranial capacity, and are believed to approximate to the Australian type The supra-orbital ridges are not more pronounced than those of the Australian, but the forehead is even more flattened and receding These skulls, which have been deposited in the museum of the University of Nebraska, indicate a race of low cerebral capacity, inferior to the modern Indians or the typical American mound-builders Their average stature was about 5 feet 10 inches Compared with typical primitive forms—those of the Javan *Pithecanthropus erectus* that of Gibraltar, and the Neanderthal skull—the American specimens seem to represent a class more recent than the last It would be rash to speculate on the importance of this discovery until the missing portions can be recovered or more perfect specimens unearthed "Even if not of great antiquity," says Prof Osborn, "it is certainly of a very primitive type, and tends to increase rather than diminish the probability of the early advent of Man in America" The same issue of this magazine contains President Roosevelt's enthusiastic account of ancient Irish Sagas, in the course of which he takes occasion to advocate the foundation of chairs of Celtic in the universities of America

The latest issue—a double number—of *Le Bambou* dated mid-December completes the first volume The articles include a note on the indigenous localities of species of Phyllostachys, an account of the vegetative development of bamboos, and a report on the growth of the species cultivated at Ermitage during the year

Among the papers read before the Botanical Society of Edinburgh, and published in the second part of vol xxiii of the Transactions and Proceedings, Mr J A Alexander communicates an article on the flora of Portuguese East Africa with illustrations detailing the more conspicuous plants The dominant order is Compositæ containing several species of Vernonia Helichrysum and Senecio but the Leguminosæ and Euphorbiaceæ are more interesting and useful Of Landolphia rubber vines only the species *florida* and *petersiana* are mentioned An account of the extra-tropical trees planted and grown in Arran by the Rev D Landsborough testifies to the mildness of the seasons in parts of Scotland, as the list includes species of the Chamærops palm the palm-lily Cordyline Eucalypts, and numerous bamboos measurements of the height and girth of the trees are recorded The discovery of an evergreen Cystopteris by Mr W Young in Aberdeenshire that receives the name of *C fragilis* var *sempervirens*, is noteworthy

It is annoying but often necessary when the names of a group of economic plants are revised to find familiar designations displaced by others more justifiable The limits of the genus Andropogon have always been uncertain and consequently in working out the nomenclature of the oil grasses of India and Ceylon, to which subject the whole of the eighth number of the *Kew Bulletin* is appropriated Dr O Stapf has found it necessary to transfer ten species to the genus Cymbopogon, to re-christen the species *muricatus*, better known as "khas-khas," by the name of *Vetiveria zizanioides* and to retain under Andropogon only the insignificant species *odoratus* This however, is only a portion of the tangle Dr Stapf has endeavoured to unravel The following names are given to the commercial oils —citronella oil is *Cymbopogon nardus*, lemon-grass oil is *C citratus*, the lemon grass oil of Malabar or Cochin becomes *C flexuosus*, Rusa grass or palmarosa oil *C martini* and *C schoenanthus* is limited to the "izkhir" of Arabia that receives the appellation of camel-grass oil

In the Journal of the Franklin Institute (vol clxii, No 6) it is announced that Mr F G Acheson, of Niagara Falls, has succeeded in making soft graphite artificially Hitherto the artificial product has been hard graphite which has been used in the manufacture of electrodes and as a pigment The soft graphite will be used as a lubricant, as a stove polish, for electrotyping and for coating gunpowder

The *Pioneer Mail* of December 14, 1906 directs attention to the extraordinary development of the manganese ore industry of India since the discovery in 1890 by Mr

H G Turner of the commercial value of the manganese ore in the Vizianagram district of the Madras Presidency It is evident that India will soon stand first as the largest producer of manganese ore in the world

IN *Concrete and Constructional Engineering* (vol I, No 6) there is an admirably illustrated article dealing with reinforced concrete bridges, by Mr W N Twelvetrees The article on steel and concrete at the Ritz Hotel, London, describes a striking example of steel-frame construction encased in concrete A new use for concrete is indicated in the description of a gas-holder tank of reinforced concrete, 84 feet in diameter and 21 feet deep, at Dubuque

THE annual retrospects published by the engineering journals are of great value for reference to workers in other fields The report on the year's progress published in the *Engineer* of January 4 is the most exhaustive that has appeared It covers the domains of mechanical engineering civil engineering water supply, gas supply war material, chemistry, metallurgy electrical engineering and sanitary engineering In the special field of mining and metallurgy the report in the *Mining Journal* of December 29, 1906 is the most complete The report on shipbuilding, in *Engineering* of January 4, shows that the past year has been very remarkable so far as marine construction is concerned The tonnage produced in the United Kingdom 2,030,990 tons, is the highest yet reached

WE have received from Mr U S Grant a copy of a report he has prepared for the United States Geological Survey (Bulletin No 284) on the mineral resources of Prince William Sound, on the north side of the Gulf of Alaska Two mines on the shores of the Sound have demonstrated that copper ore of good grade occurs in the district Erosion in very recent time has been general, so that no considerable secondary concentration of ores exists The ores of possible commercial importance have all the characteristics of primary deposits and irregularity of form is to be expected Developments should consequently be confined to following the ore

THREE memoirs (*Boletins* Nos 40, 42 and 43) issued by the Corps of Mining Engineers of Peru afford striking evidence of the careful attention that is now being devoted by the Peruvian Government to the subject of irrigation In *Boletin* No 40 Mr G I Adams discusses the distribution of water in the departments of La Libertad and Ancachs the memoir being accompanied by a coloured hydrological map In *Boletin* No 42 Mr A I Stiles gives the results of a careful technical investigation of the lagoons of Huarochiri, in the department of Lima He appends a contoured map showing the position of the lagoons and a map illustrating his scheme for increasing their capacity In *Boletin* No 43 Mr C W Sutton and Mr A I Stiles deal with the water supply of the department of Piura

THE United States Geological Survey continues to devote special attention to the investigation of the mineral resources of Alaska The resources of Kenai Peninsula in the most northern portion of the great upward bend of that part of the Pacific coast line enclosing the Gulf of Alaska, form the subject of an interesting report by Mr F H Moffit and Mr R W Stone (Bulletin No 277) The former deals with the goldfields of the Turnagain Arm district, where gold in the stream gravels is very unevenly distributed, and the latter describes the coalfields of the Kachemak Bay region, where lignites occur in beds ranging up to 7 feet in thickness, but of low heating power The geology and coal resources of the Cape Lisburne region are dealt with by Mr A J Collier (Bulletin No 278) The coals are of two classes, low-grade bituminous coal of Mesozoic age and high-grade bituminous coal of Palæozoic age The Mesozoic coalfields cover an area of more than 300 square miles, and contain at least 150 feet of coal distributed in forty or fifty seams, ten of which are more than 4 feet thick The Palæozoic coals occur in limited areas, and the beds are much crumpled and broken, but on account of their good quality will in the future contribute an appreciable addition to the value of the mineral output of Alaska The Rampart gold-placer region in the central part of Alaska is described by Mr L M Prindle and Mr F L Hess (Bulletin No 280) The placers are of two general types as regards their origin, placers of ordinary concentration from the disintegration of the bed rock and placers formed through re-concentration of the gold in older gold-bearing gravels by the cutting of streams The gold of the re-concentrated placers is generally smoother and brighter than that from the others, contains less quartz and iron, and is, therefore, higher in value per ounce The gold has probably come from comparatively small veins distributed through the surrounding rock

A SERIES of experiments has been carried out, the *Pioneer Mail* states, at the Plague Research Laboratory at Bombay with the view of determining the germicidal properties of pure nickel and nickel alloy, and to test the possibility that disease might be conveyed by coins Pure nickel nickel and copper, copper, and silver coins were experimented with and the results are said to show that all the coins had bactericidal action on the plague bacillus

THE law of error forms the subject of several recent papers, including two by Prof C V L Charlier in the *Arkiv fur matematic Astronomi och Fysik* (Stockholm) ii, 8, 15 and one by Prof F Y Edgeworth in the Journal of the Royal Statistical Society lxix, 3 These papers deal with the cases in which the frequency curve consists of a series of terms of which the first term represents the ordinary well known "law of error" and the diagrams showing the effect of the succeeding terms, which Prof Edgeworth reproduces from Prof Charlier's "Researches into the Theory of Probability" will give non-mathematical readers a good general idea of the effect of the corrections on the form of the curve

UNDER the title *Rivista di Scienza*, a new Italian journal is announced dealing with questions of a general nature relative to various branches of science and the connection between them Contemporaneously with the Italian edition, an international edition will be published containing original contributions printed in either of the four principal international languages in which they are written The managing committee consists of Profs Giuseppe Bruni (Parma), Antonio Dionisi (Modena), Federico Enriques (Bologna), Andrea Giardina (Pavia), and Ingegnere Eugenio Rignano (Milan) The editorial secretary is Dr Giuseppe Jona, Milan, Via Aurelio Saffi, 16

THE Decimal Association has recently issued two more pamphlets One, which is sold at 3*d*, gives Lord Kelvin's views on the advantages of the metric system, the opinions of numerous other eminent men, and explanatory tables, the other by Mr S Jackson, is entitled "The Inch Absurdity," and is intended to demonstrate "the utter folly and impossibility" of recent proposals to adopt the

inch, square inch, and cubic inch as standards of length, area, and volume, and the weight of a cubic inch of water at a certain temperature as the standard of weight

THE issue for 1907 of the "Science Year-book, with Astronomical, Physical and Chemical Tables, Summary of Progress in Science, Bibliographies and Diary," edited by Major B F S Baden-Powell, and published by Messrs King, Sell and Olding, Ltd, differs little from that of last year A general article of fewer than ten pages on the progress of science in 1906 has superseded the comparatively full summaries in various scientific subjects given in former years We observe that the "Year-book" can be obtained in an abridged form without the diary

THE twenty-third annual issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland," which has been published by Messrs Charles Griffin and Co, Ltd, provides a convenient short record of the work done by numerous societies and Government institutions in science, literature, and art during the session 1905–6 The information has been compiled from official sources, and the majority of societies and associations included in the volume have demonstrated, by published papers, their activity in extending and disseminating knowledge The editor may be congratulated upon the production of a work of reference which is of distinct service

A PRICE-LIST of invar and its applications, issued by Mr J H Agar Baugh, 92 Hatton Garden, E C, contains some interesting notes on the specific properties of this valuable alloy of nickel-steel Invar is sold in three grades, and the guaranteed maximum of the coefficient of expansion of the middle quality is only 0.0000015 per 1° C, while that of the highest grade is much less For pendulum rods, compensation balances for marine chronometers and pocket watches standard measures of length, tapes for measuring base-lines and many other purposes, invar has proved particularly valuable, and its use in scientific instruments is likely to be greatly extended

THE first number of a new weekly journal known as *Electrical Engineering* was published on January 3 The periodical will deal with the subject of electrical engineering, particularly from the practical and utilitarian aspect, and is intended for the engineer rather than the electrician The number of well-reproduced drawings to scale and of special photographs showing details of constructional work is large, and the paper is, as a whole, particularly attractive Among other articles may be noticed one on the new Great Northern, Piccadilly, and Brompton Railway, and an incidental reference in another part of the paper gives the information that all the rolling-stock for the latest tube is of Continental manufacture If the standard of the first number is maintained, the new periodical should have a successful career

OUR ASTRONOMICAL COLUMN

EPHEMERIS FOR COMET 1906*g* (THIELE).—A further ephemeris for comet 1906*g*, extending to February 16, is given in No 4143 of the *Astronomische Nachrichten* by Herr Georg Dybeck This ephemeris shows that the comet is now (January 10) about 1° north of θ Draconis, and is only about one-third as bright as when discovered

THE OBSERVATION OF TOTAL SOLAR ECLIPSES.—Observers of total eclipses of the sun will find much to interest them in the address delivered by M le Comte A de la Baume Pluvinel to the Astronomical Society of France, and published in the Bulletin for December 1906

The lecturer dealt chiefly with the details of the preliminary preparations which commence at the moment that the astronomer decides to observe the eclipse—usually some months before the actual day—and are not concluded until the observations are actually in progress In eclipse reports these preparations are generally only summarily dealt with and the inexperienced reader will be surprised, on reading the lecture, to learn of the innumerable *minutiae* which *have* to be considered and dealt with if success is to attend the observations The lecturer also named the most famous eclipse observers in the several countries which have participated in these important observations, directing special attention to any exceptional methods employed, as for example, the utilisation of men-of-war and their trained *personnel* by Sir Norman Lockyer at several eclipses

OBSERVATIONS OF MARS.—In the December (1906) number of the *Bulletin de la Société astronomique de France*, M José Comas Sola, director of the Fabra Observatory (Barcelona), gives an illustrated account of his observations of Mars during the opposition of 1905 The following points, among others, are worthy of notice:—On April 26 M Sola saw a "*lac*" at the intersection of Phison and Orontes, and the Euphrates, although perfectly visible, was always diffuse, despite the fact that, at times, the seeing was very good On April 28 changes were observed which were evidently due to atmospheric changes on the planet The "seeing" on May 9 was superb and as shown by the drawing for this date, "*canaux*" and "*lacs*" were seen very distinctly, the latter forming the corners of the pentagon around the Elysium The Propontis was seen to be rather dark and double, with good "seeing," on May 17, at 11h 40m (G M T) but at 12h 40m it seemed quadruple formed by four "*lacs*" disposed at the corners of a square

TRANSIT-CIRCLE OBSERVATIONS.—Parts i to iii, vol iv (second series), of the Publications of the U S Naval Observatory contain a large number of transit-circle observations, with their discussions and reductions

In part i the observations made with the 6 inch transit circle during the period 1900–3 are dealt with and the results tabulated It is interesting to note that whilst the variations of this instrument are much smaller since the substitution of brick for stone piers, they are still important, and Prof Littell from a discussion of the constants for 1903, shows that they are dependent upon the temperature variations The azimuth constant shows a regular annual variation of −0.0115 per 1° F and a diurnal variation of about half that amount In part ii the observations made during 1866–91 are collected and discussed in a uniform manner whilst part iii is devoted to the discussion of the 6 inch transit-circle observations of standard and zodiacal stars made during 1901 and 1902

THE "COMPANION TO THE OBSERVATORY."—Only a few changes are to be noted in the current issue of the indispensable annual the "Companion to the Observatory"

Owing to the continued increase in the number of known variable stars the list of ephemerides supplied by M Lœwy is given in a somewhat different form and the Greenwich mean astronomical time, from noon to noon has been substituted for the civil, midnight to midnight time employed in recent years The addition of stars fainter than magnitude 6.5 has increased the number of lunar occultations given The usual diagram of Saturn's satellites is omitted because their plane passes through the earth during the current year The "Companion" is published by Messrs Taylor and Francis, price 1s 6d

"THE HEAVENS AT A GLANCE 1907"—For all who take an interest in astronomical phenomena and have but little time to spare and but modest instrumental equipment Mr Mee's card, "The Heavens at a Glance" is the handiest and cheapest calendar published As in previous issues it gives the chief events for each month the dispositions of the sun, moon, and planets throughout the year notes on eclipses, meteor showers and variable stars and a pair of star maps by which the observer may recognise the chief constellations and stars at any season of the year The price is sevenpence, post free from Mr A Mee Llanishen, near Cardiff

THE GEOLOGY OF MINING AREAS

MR R G McCONNELL has contributed to the "Annual Report of the Geological Survey of Canada," vol xiv, part B (1905, price 25 cents), a well-illustrated paper of wide interest on the Klondike goldfields The general topography and the communications with other regions are described, and the full-page landscapes convey an excellent idea of the conditions under which mining is carried on Roads have been developed, the White Pass railroad is completed, and it now takes less than a week to reach Dawson City from Vancouver In the latitude of only 60° N, the surface-stratum is continuously frozen, and unfrozen ground is reached at depths of from 60 feet to 200 feet In summer, gravel-beds which are unprotected by moss thaw down to a depth of from 6 feet to 10 feet (p 9) The gold-bearing quartz veins are included for the most part in the Klondike series of schists Microscopic evidence supports the view that these schists are of igneous origin, since a passage is traceable from uncrushed granitoid types to mylonitic sericite-schist (p 19) Cainozoic rocks are found folded in with the schists in Last Chance Creek, thus proving the recency of earth-movement in this area In the basin above Rock Creek these beds contain lignites of Upper Eocene age The low-level gravels of the creeks, which are so important to the gold-miner, include bones of the mammoth, as well as of many existing northern animals (p 29) The greater part, at least, of the Klondike gold is detrital, and is derived from the small but very numerous quartz-veins associated with the older schists (p 61) Many of the grains of alluvial gold enclose quartz, and a few are themselves enclosed in quartz The decay of the rocks must have been enormous to allow of the vast accumulation of auriferous gravels The quartz veins are much younger than the schists in which they lie but are older than the andesites and quartz-porphyries of the district Lode-mining has so far made little progress, but work among the gravels seems still increasing

Mr McConnell has also issued through the Geological Survey of Canada a paper on mineral discoveries on Windy Arm, Tagish Lake, Yukon (1905), where a new mineral district has been opened The quartz-veins here bear a considerable variety of silver ores, ranging from highly argentiferous galena to stephanite and pyrargyrite

In the twenty sixth *Boletín del Cuerpo de Ingenieurs de Minas del Peru* Señor Luis Pflucker describes the gold-bearing deposits of the province of Sandia All the detrital material at the foot of the mountains contains gold, without regard to the nature of the underlying rock The proximity of a moraine formed by an existing glacier makes it probable that the detritus has been brought into the field by glacial action Hydraulic mining is carried on, as may be seen in the illustrations to the bulletin

Mr Harold S Harger brought together a very instructive exhibit of diamond-bearing rocks, and of the minerals associated with the diamond in South Africa, during the meeting of the British Association in Johannesburg in 1905 His paper on the diamond-pipes and fissures of South Africa is now published (Trans Geol Soc of South Africa, vol viii, 1906, p 110), and forms a comprehensive and welcome contribution, certain details of which are sure to meet with healthy criticism Many hundreds of pipes of the Kimberley type are now known to exist, "from the central and northern portions of Cape Colony, throughout Griqualand West, in parts of Damaraland and Rhodesia also north of the Zambezi, and as far east as British East Africa In the Orange River Colony, there is hardly a district between the Wesselton Mine near Kimberley, the Drakensberg Range, and the Orange River, in which the much-sought-for volcanic breccia has not been discovered" The diamond-pipes were opened, in all probability, after the outpouring of the amygdaloidal lava of the Drakensberg, since fragments resembling this rock occur in the "blue ground" of the Jagersfontein Mine From this and other evidence (p 115) Mr Harger conclude that they are of late Triassic or Jurassic age The pipes occur typically in groups, perhaps twenty or thirty near one another, and the large ones seem to contain the truly rich material While some are necks, circular or oval in section, others are mere swellings along lines of fissure, their thinned-out ends being sometimes traceable for miles. Mr Harger discusses the composition of the breccia that fills them, and believes that olivine was not an important constituent of the original mass The analyses quoted from Vogelfontein and the Schuller Mine (p 120) certainly do not indicate a peridotite-magma, though the rock in the Kimberley Mine, on the other hand, yields 32 38 per cent of magnesia The "diamond-fissures," to which special attention is invited by the author, contain a hard basic rock of a less brecciated and more porphyritic character Mr Harger believes that the material in the pipes was injected by explosive action, accompanied by a certain amount of heat, though this was not enough to metamorphose the surrounding rocks distinctly The breccia, in his opinion (p 122), boiled and churned up its constituents in the vent Thus, in opposition to Prof Bonney's view (p 126), he holds that the rounding of such masses as the included eclogite boulders is due to attrition in the pipe Certainly no one who has seen the breccia of a diamond-pipe, such as that of the Schuller Mine, near Pretoria, abutting on its apparently unaltered wall, can associate

FIG 1—Weathered Kantoor Sandstone, Transvaal.

the rock with the phenomena of ordinary igneous flow Equally distinctive is the evidence of the derivation of the green pyroxenes and the garnets, to mention no other minerals, from some previously consolidated and deep-seated mass Few geologists, we fancy, will now dispute the conclusion, first indicated by Prof Bonney when he described the eclogite from Jagersfontein, that the diamond itself is a derived mineral in the pipes and fissures, and arose (p 134) from "an ultra-basic 'carbon-saturated' zone at great depth," through which the "kimberlite" broke The diamond becomes thus linked in our minds with the primitive masses of inorganic graphite, and, still more interestingly, with the nascent carbon dioxide, which still streams upward from the unexplored regions of the crust

In the same number of the Transactions of the Geological Society of South Africa (p 147) direct reference is made to these "juvenile" emanations by Prof Beck, of Freiberg, in a paper on the relation between ore veins and pegmatites The author's purpose is to connect the pegmatites with the aqueous solutions which remain after the consolidation of an igneous mass The old theory of "segregation-veins" is set aside, as has been done by

other writers, and Prof Beck remarks that, since the aqueous solutions in the fissures cooled very slowly, and "their great liquidity was extremely favourable to diffusion of the dissolved substances, crystals of large size are frequently found in pegmatites" While thermal waters found their way to upper parts of the crust, the solutions that resulted in pegmatite-veins represent material retained at considerable depths Hence ore-deposits associated with pegmatites become exposed only after long ages of denudation Prof. Beck cites several examples where tin, copper, and gold are among the substances deposited in connection with pegmatites

Dr G B Trener (*Verhandlungen der k k geol Reichsanstalt*, 1905, pp 366 and 372) is conducting experiments to show that metals undergo diffusion in solid crystalline rocks at temperatures far below the melting points of the metals employed The complete results are to be published in the *Jahrbuch* of the Reichsanstalt as a chapter of the description of the Cima d'Asta, but the preliminary announcements have already aroused discussion Among the curious points raised by Dr Trener, is the resistance of mica to diffusion of metals in a direction perpendicular to its cleavage planes, well-developed mica-schists may thus be practically impenetrable when their foliation-planes are perpendicular to the direction of diffusion

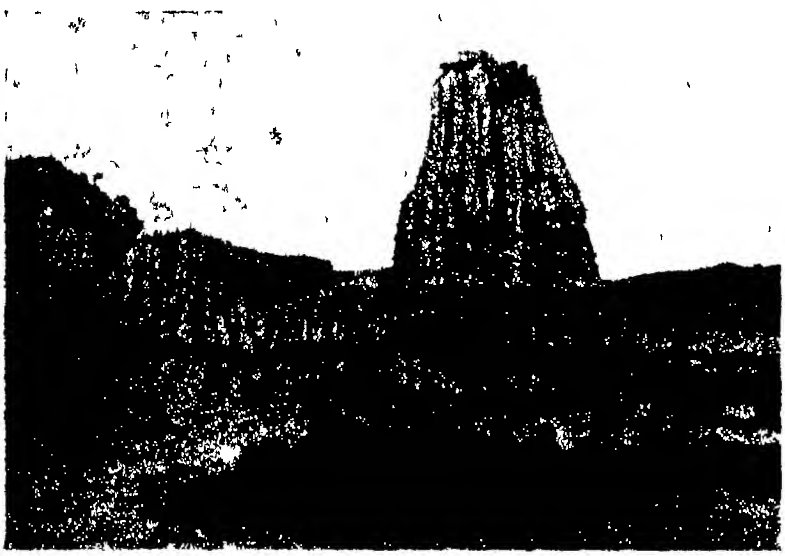

FIG 2 —Earth pillars, south of Alkmaar, Transvaal

The Report of the Geological Survey of the Transvaal for 1904 has been noticed already in NATURE (vol lxxiv, p 646) The volume for 1905 has now been issued, dated August, 1906, liberally illustrated with plates and coloured geological maps and sections, and at the same moderate price of 7s 6d The director, Mr H Kynaston, describes a recent survey of the Komati Poort coalfield, which is conveniently situated on the Delagoa Bay side of the country He reminds us of the record of 25 feet of coal in 33 feet of strata passed through by a bore-hole near Tenbosch Station in 1903, and remarks that this massive seam may underlie the smaller ones that have been proved at various points Arguments are given to show that the horizon of these coal-bearing beds, and those of the Transvaal generally, may be in the Beaufort series, and not in the underlying Ecca series, as has been generally supposed (p 25) Mr Kynaston also describes a Coal-measure series (p 35) in the Bushveld area west of the Pietersburg railway The igneous rocks of this region present many points of interest, especially in the occurrence of bands of magnetite, resembling dykes, associated with, but not passing into, a considerable mass of norite Similar bands are well dealt with by Mr Hall in a later paper in this report (p 73) Our field-inspection of these iron ores, under the guidance of Mr Kynaston, would certainly suggest that they were igneous intrusions of an extremely basic type

Mr A L Hall (p 41) describes the fine country between Lydenburg and the Devil's Kantoor, or Devil's Shop, so called from the fantastic weathering of the sandstone masses near the edge of the great escarpment Gold-mining is carried on in this hilly region, and a lime industry has sprung up near Godwan River Station through the working of secondary deposits of calcite in the dolomitic series Mr Hall, we think wisely, introduces the descriptions of the microscopic characters of his rocks, as explanations of their structure, side by side with the account of their features in the field A rock believed to be a tuff is interestingly recorded (p 53) among the otherwise intrusive igneous masses found in the Transvaal system The fine illustrations to the report show the escarpment of the Kantoor quartzite, with the rapid descent towards the old granite on the east, the gorge in the far younger quartzite of the Pretoria series, between Waterval Boven and Waterval Onder, where the traveller from the monotonous plateau of the Transvaal welcomes the picturesque notching of its edge, and other scenes from this noble region, including the weathered quartzite (Fig 1) of the Kantoor itself

Another photographic illustration (Fig 2) shows the detrital sand resulting from the weathering of the older granite, which is now eaten out into pillars as much as 25 feet high, with sometimes a cake of more resisting rock upon the top

Passing over other papers in this report, as unfortunately must be the case in a general notice, we may mention Mr Mellor's account of the Witbank Coalfield near Middleburg on the main plateau (p 81) The Permian glacial conglomerate has here supplied, during an epoch of denudation, much of the material of the overlying Beaufort (?) Coal measures The coal-seams, one of them being 24 feet thick, are described and illustrated by sections (p 97, &c) The presence of fine muddy layers raises the ash even in some of the workable coal, to 17 per cent, and the ash rarely falls below 7 per cent

Mr Tweddill (p 106), in a handsomely illustrated paper, describes some ruby bearing rocks from the Leydsdorp district, notably a beautiful example consisting of a pale pyroxene, kyanite and finely granular ruby He holds out hopes, if we read him rightly, that ruby may be in time discovered on a scale of commercial importance in the Transvaal G A J C

MEN OF SCIENCE IN AMERICA

THE issue of *Science* for November 23 contains an article by Prof McKeen Cattell on the selection, and arrangement in order of merit, of a thousand American men of science A table was compiled from lists of fellows of societies, biographical dictionaries, "Who's Who," &c, of the numbers of persons engaged in each branch of science It appears that chemists are the most numerous in America at all events, forming 164 per 1000 of all scientific men, zoologists coming a close second with 155 per 1000 Anthropologists stand at the foot of the list with only twenty-three, but neither statisticians nor economists, it would seem, were taken into account Ten leading representatives of each science were then asked to arrange in order of merit a certain number of students of that science, the numbers fixed being roughly proportionate to the totals in the table first compiled The positions assigned by the different judges to every individual were averaged, and the probable error of the average posi

tion of each calculated A general list, including representatives of all the sciences, was also compiled by interpolation, but neither this nor the separate lists are published An interesting table is given showing the divergences between the ten judges in the case of psychology as an illustration The order of merit given by one of the judges is very much more accordant with the average order than those of the others, and they differ considerably *inter se*, though more if we understand the table rightly, in the case of those at the bottom of the list than of those towards the top Of the first hundred scientific men on the list who are eligible, sixty-one are included among the ninety-seven members of the National Academy of Sciences The discussion of the grades and probable errors is continued in *Science* for November 30, and in a third and concluding article in the issue for December 7 Prof Cattell investigates the geographical distribution of American men of science according to place of birth and place of residence The figures as regards the former are extremely striking The production or "birth-rate" of men of science per million of the population ranges from about 109 in Massachusetts—which stands far above the other States—and eighty-seven in Connecticut down to rates of only one or two in several of the southern States It is argued that differences in stock can scarcely be great enough to account for this, and that accordingly the production of scientific men must be largely a matter of circumstance As regards the place of residence, interesting tables are given showing the institutions with which the men of science taken into account are connected The work forms part of an extended investigation which Prof Cattell has now been conducting for some ten years, and on which he has published several previous memoirs

WAVE ACTION IN RELATION TO ENGINEERING STRUCTURES

A PAPER on wave action in relation to engineering structures, by Major D D Gaillard, issued as a professional paper (No 31) of the Corps of Engineers of the United States Army, contains a great deal of information useful to engineers engaged in designing and constructing sea defences and other works subject to wave action

The first part of the book is devoted to a general consideration of the theory of the formation of waves, and to a notice of the information that already exists as to this This as the author remarks, is embraced in so many volumes that the work of comparing theoretical and observed wave characteristics is rendered very tedious The investigations that have previously been made into wave action, and of which the results have been published, relate principally to deep-water waves, whereas there is very little recorded information as to the action of waves in comparatively still water to which engineering structures are exposed

Major Gaillard the author of this book was for several years engaged upon works of harbour improvement on the South Atlantic coast and the Great Lakes of America

Although the waves to be dealt with in Lake Superior are not of the magnitude of those in the open sea, yet the author's observations cover waves of various dimensions extending up to 300 feet in length and 23 feet in height and the results are recorded of several hundred observations of their length, height, period and depth in which they broke and to which their effect extended Numerous examples are also given of the effect of waves in moving large masses of stone and other material The force of the waves breaking on piers, and other marine structures, was measured both by the marine dynamometer of the class used by Mr Thomas Stevenson more than half a century ago and also by dynamometers of special construction made under the author's directions The general type of the Stevenson dynamometer used had discs of from 3 inches to 9 inches, with springs varying in strength from 10 lb to 50 lb for every inch of elongation The greatest dynamical force recorded with these when used at Dunbar, in Scotland, was 7840 lb per square foot with waves about 20 feet high These dynamometers only measure the dynamic, and not the static pressure, and give only a maximum reading for a storm observation, and are affected in their working when there is much sand in the water

The instruments invented and used by the author, besides the Stevenson type, consisted, in one case, of a steel plate, having an area of one square foot, attached to two elliptical springs similar to those used for carriages, the distance between their centres being 6 inches, the reading of the amount of compression due to the action of the wave being recorded by a rod attached to an index which acted on a paraffin surface The instrument, before being fixed, was rated by having weights placed on the plates and noting the corresponding compressions The other dynamometer used by Major Gaillard consisted of a plate covering a square foot attached to a horizontal cylinder filled with water, over the flange of this cylinder was placed a diaphragm of india-rubber ½-inch in thickness having a face of one square foot A ⅜-inch pipe led from the cylinder to a tank located in the observing station on the pier From this pipe there was a communication to a modified form of Bourdon gauge fixed 19 feet above the centre of the diaphragm, and which registered pressures up to 30 lb per square inch Communication with the tank having been shut off, any pressure applied to the diaphragm was transmitted by the confined hydrostatic column to the gauge More than a thousand readings of wave action were taken with this class of dynamometer while the author was in charge of the works but only two storms of consequence were encountered So far as the observations went, the instrument appears to have given satisfactory results

The text is accompanied by a number of illustrations taken from photographs of waves

SCIENCE IN EXAMINATIONS FOR THE HIGHER CIVIL SERVICE

THE kind of education received and the subjects studied by future civil servants must have a great and far-reaching effect upon the influence exerted by the public departments which administer the multitudinous and diverse affairs of our scattered Empire The methods adopted for the selection of such officers must, therefore, be wisely chosen, and in any examinations designed to facilitate the process of discrimination between men offering themselves for these positions the subjects in which candidates are tested must be those appropriately related to the work of the department in which successful candidates will be employed and at the same time, those most likely to test essential fitness for public work These and similar principles have been widely canvassed recently both in public addresses and in the Press Certain changes in the examinations for the selection of Foreign Office clerks and attachés in the Diplomatic Service are to be introduced, and the new regulations have not met with universal approval It will assist clearness of thought first to compare briefly the existing regulations for the appointments concerned with those shortly to come into force

Candidates for clerkships on the establishment of the Foreign Office and for attachéships in the Diplomatic Service will, after July 1, instead of being examined according to special regulations which have governed these appointments hitherto, be required to take the combined examination for open competitions for the Home Civil Service (class 1), India Civil Service, and Eastern Cadetships This decision profoundly modifies the conditions of selection for service in the Foreign Office and the Diplomatic Service In the past there have been nine obligatory subjects—arithmetic, handwriting and orthography English composition, précis writing, French, German general intelligence, geography, and the history of Europe from 1789 to 1880 inclusive In addition, candidates have been able to offer any two of the following languages, viz , Latin, Italian, Spanish Portuguese, Russian, modern Greek, and Arabic In the examination which such candidates will have to take after July 1 next, papers will be set in thirty-two different subjects, from which a selection must be made by the candidate French and German will be the only obligatory subjects, and candidates will have to reach a high qualifying standard in translation, composition, and oral examination in both

these languages Portuguese, Russian, and modern Greek are no longer optional languages The maximum marks to be obtained in each subject are, as a rule, 500 or 600, but 1200 may be scored in each of the two extensive divisions of mathematics included

Though candidates for the appointments in the Foreign Office and the Diplomatic Service may make a selection from the long list of subjects referred to, the number of papers taken must be such that the maximum of marks that can be obtained from the subjects chosen is limited to 4000 Under the new conditions, the man who attempts to train himself by attendance at a cramming establishment, for the sole purpose of succeeding in the competition, will have a much smaller chance of success than a candidate who has graduated in honours after a university course The student who has made himself master of any of the great divisions of knowledge will be able to acquit himself with credit For example 2400 marks may be gained in science, 2400 in mathematics, 1200 in French and German, 1800 in Latin and Greek, 1000 in Greek and Roman history, and 1300 in English and general modern history but in any case the total number of marks attainable in the subjects selected by a candidate must not exceed 4000 The underlying principle seems to be to obtain somehow students who have benefited by a thorough study of at least one department of knowledge, of whatever kind, apparently the intention is to secure men of high attainments, no matter in what subjects they have specialised, and to insist upon a good knowledge of French and German from all candidates

The schedule of subjects is sufficiently comprehensive to afford all ordinary students a fair opportunity to distinguish themselves The candidate who has made science the staple subject of his university course will compete on almost equal terms with one who has studied classics and classical history, while the candidate who has specialised in modern languages and history need be at no disadvantage

The comprehensive subject of geography however, which is at present obligatory is not included among the subjects from which candidates may, after July 1, make their selection, and it is this omission which has given rise to much discussion and many protests In reply to a question on the subject in the House of Commons, the Foreign Secretary said —" Although a knowledge of geography is no doubt very useful it is a subject with which men of general education are generally acquainted and which is easily acquired after entry into the service " Distinguished geographers have since shown how far this is from being the case Sir George Goldie, in an address to the Royal Scottish Geographical Society in Edinburgh published in the *Geographical Journal* for the present month, relates a notable instance of the difficulties to which a want of geographical knowledge may give rise "A good many years ago a territorial arrangement with France was in discussion, and I was invited to consider it The French proposals appeared to the Foreign Office satisfactory, but I found that they were expressed as might have been expected, in longitudes reckoned from the meridian of Paris while the map with which our Foreign Office had considered these proposals was made in Germany and reckoned its longitudes from the meridian of Greenwich The arrangement in question was never completed "

Mr Douglas Freshfield, in his address last Friday to the Geographical Association of which he is president dwelt upon the same point, and said he could give similar instances to that related by Sir George Goldie Mr Mackinder has shown in a recent letter to the *Times* that Sir Edward Grey's description of geography is that of the subject as it was studied twenty years ago and not as it is now understood and taught Substantial reasons have in fact, been given for the inclusion of geography among the other branches of science from which candidates may make their selection

It is hardly necessary to remind readers of NATURE that geography has in recent years taken its place among those branches of knowledge which are studied on scientific lines No geographical teaching is now recognised by the Board of Education as satisfactory in secondary schools unless it has a basis of practical exercises and follows scientific methods The subject has obtained university recognition, and is now taught by practical work in the laboratory and the field As Mr Mackinder has pointed out, "geography has its own modes of thought and its own points of view which are not to be obtained in a hurry " Mr Freshfield was able to point out in his address to which reference has been made, that there is evidence that the Civil Service Commissioners are beginning to reconsider the matter and that it will not be long before the claims of geography will be fully recognised by the inclusion of the subject, dealt with in accordance with modern scientific methods, as one of those in which candidates may present themselves for examination

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD — The natural science board has issued a certificate stating that the work submitted by Mr G F Herbert Smith, New College, is of sufficient merit to entitle him to supplicate for the degree of Doctor of Science

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WE learn from *Science* that Columbia University and Barnard College will receive 2000*l* each under the will of Mrs Annie P Burgess

SIR W T LEWIS has promised 1000*l* toward founding a chair of mining at Cardiff College, University of Wales provided 30,000*l* is raised in contributions from coal owners, royalty owners and workmen

PROF OTTO BENNDORF, professor of classical archæology at the University of Vienna, died on January 2 at the age of sixty eight years He was well known owing to his works on archæological subjects, and to the excavations he conducted in Asia Minor

ADDRESSING a gathering of science and art students at Gravesend on January 2, the Earl of Darnley is reported by the *Daily Chronicle* to have made the following confession —" I place myself before you as an example of deficiency in education I went through the ordinary public-school course, and received a university education I found myself at twenty two a B A of Cambridge, with a certain knowledge of Latin and Greek, which I have never found of any particular use, but without any knowledge of French, German, or science From my example I hope you will glean some benefit by securing that knowledge which it is now too late for me to acquire "

PROF A SCHUSTER, F R S, has resigned the position as Langworthy professor of physics and director of the physical laboratories in the Victoria University of Manchester Prof Schuster's connection with the University dates from 1871, when he entered Owens College as a student In 1873 he held the post of honorary demonstrator in physics under Prof Balfour Stewart, and in 1881 he was appointed to the newly-created chair of applied mathematics which he resigned to become professor of physics in 1888 Both the Council and the Senate have placed on record by formal resolutions their regret at Prof Schuster's resignation, which is to take effect at the close of the present session and their sense of the very great service which he has rendered to the University by his work as teacher, his direction and administration of the physical laboratories, his contributions to the advancement of science, and the prominent part which he has taken in relation to the re-organisation of the University A general hope has been expressed that Prof Schuster may still remain in close connection with the University and take an active part in its affairs generally, as well as specially in connection with scientific research

PROF E RUTHERFORD F R S, Macdonald professor of physics in the McGill University Montreal has been appointed to succeed Prof Schuster as Langworthy professor and as director of the physical laboratories in the Victoria University of Manchester Prof Rutherford is a native of New Zealand After a distinguished academic career in the New Zealand University he proceeded to Cambridge as an 1851 Exhibition scholar, and entered

Trinity College, prosecuting research in the Cavendish Laboratory He was one of the pioneers of wireless telegraphy, and occupies a high position in the scientific world owing to his experimental work on the ionisation of gases, the discovery of the radium emanation, and the foundation of the now generally accepted theory of radio-activity It is expected that Prof Rutherford will arrive in Manchester early in the summer with the view of taking up the regular duties of the professorship at the beginning of the session in October next

JANUARY has again brought with it conferences of teachers of all grades in various parts of the country In London, large numbers of schoolmasters, schoolmistresses, and educational administrators have met under the auspices of the London County Council, and discussed for three days subjects as various as silversmith's work and the teaching of phonetics In Bradford, the educationists of the north of England have, in well-attended meetings, ranged over the field of education Associations of teachers of special subjects have also held meetings characterised by their enthusiasm Such gatherings are to be welcomed as maintaining an active interest in education, and as likely to send teachers back to their work with renewed energy and broader knowledge It is worthy of note that in none of the meetings has science or mathematics taken a prominent part We have no reason to regard this as indicative of a falling off in the interest in these important parts of the school curriculum it rather directs attention to the fact that in recent years questions concerning mathematical and scientific teaching have dominated the programmes of teachers' meetings, and much thorough discussion has led to improved teaching and obviated, for the present, the need for further argument At the Bradford conference an important session had for its subject the development of technical education in a large manufacturing centre Prof Charnock, of Bradford and Principal Reynolds of the Manchester Technical School, read papers Mr Reynolds said we need more intelligence and more knowledge on the part of our working people He suggested, first, the need for the extension of the age-limit in higher elementary schools to sixteen years There is an advantage in selecting in each of suitable localities of a town one of the elementary schools and giving it an extended curriculum, staffing and equipping it accordingly, such school being fed from the elementary department of the school and from neighbouring elementary schools, and supported by a scheme of scholarships Secondly, the enactment of a law forbidding the employment of young people in working overtime until they reached their eighteenth year, so as to give full opportunity for attending evening classes Thirdly the establishment of one-day courses of specialised instruction in the technical school or college for selected apprentices in engineering and other similar important industries He urged that the present need is a better appreciation of the requirements of general and secondary education so far as to secure a longer school life, and thus a more complete preparation for specialised training

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 15 1906 —"The Effect of Temperature on the Activity of Radium and its Transformation Products" By Dr Howard L **Bronson**. Communicated by Prof E Rutherford, F R S

A large number of investigators have attempted to alter the activity of various radio active substances by subjecting them to very high and also to very low temperatures Among all these attempts only two, so far as the present author is aware, have apparently given positive results

The experiments now described show no evidence whatever of any change in the activity of the transformation products of radium when they are subjected to temperatures between $-180°$ C and $1600°$ C If any change does take place it is very small and cannot be more than 1 per cent in the case of radium C for temperatures between $-180°$ C and $1600°$ C, nor more than 1 per cent in the case of the emanation or radium B for temperatures between $-180°$ C and $1500°$ C

There is thus removed the only known exception to the general rule, that the activity of radio-active substances is not affected by temperature

"The Photoelectric Fatigue of Zinc" By H Stanley **Allen**. Communicated by Prof H A Wilson, F R S

Hertz's observation that ultra-violet light can facilitate the passage of an electric spark led to the discovery of other photoelectric actions In the earliest experiments on the photoelectric effect of metals it was noticed that the action was diminished by exposure to light Thus Hallwachs, who found that a metal becomes positively electrified under the influence of ultra-violet light, states that "old surfaces no longer show the phenomenon The radiation itself lowers the potential to which the plates can be electrified, so that with any succeeding experiment made with the same surface, the potential obtained is lower, while the rise to it takes place more rapidly, and the decrease is greater than when for the same interval of time between the experiments the plate was not illuminated" This diminution of the photoelectric action is spoken of as the "fatigue" of metals under the influence of light, and has received attention from many physicists

The present paper deals with the manner in which the photoelectric activity of zinc diminishes when the metal is exposed to light

The experiments described show that it is necessary to employ the sum of two exponential terms in order to obtain an adequate representation for the photoelectric fatigue curve of zinc Just as Rutherford has explained the curves of decay for the excited activity of radium and thorium as a consequence of successive changes, so it is possible to explain the present results as due to two consecutive changes The nature of the modifications thus suggested is left an open question

It is also shown that the longer waves of light can bring about a change in the opposite sense, that is to say, they can produce a certain amount of recovery of photoelectric activity

Entomological Society, December 5, 1906 —Mr F Merrifield, president, in the chair —*Exhibits* —A W **Bacot** A specimen of *Catocala nupta*, taken at rest at Hackney, November 9, 1906, remarkable for having two well-developed tarsi on the left fore-leg Also three ♀ specimens of *Lasiocampa quercus*, L, bred from larvæ from Cornwall in 1906 One of these larvæ had been submitted to a pressure of from 11 to 30 atmospheres (405 lb to 450 lb per square inch) on two occasions, a pressure which had proved fatal at once to a frog, used as a control experiment —Dr T A **Chapman** A long series of *Hastula hyerana*, Mill, bred in 1906 from larvæ collected at Hyères, illustrating the spread of melanism in this species, and a diagrammatic map of the neighbourhood to explain its distribution in that area —Dr F A **Dixey** Specimens of *Teracolus omphale*, Godt, bred by Mr G A K Marshall, to show that under arranged conditions of moisture and warmth the wet-season phase might be artificially induced —*Papers* —*Xanthorhoë ferrugata*, Clerck, and the Mendelian hypothesis L B **Prout**.—The diaposematic resemblance between *Huphina corva*, Wallace, and *Ixias baliensis*, Fruhst Dr F A **Dixey**.

Chemical Society, December 20, 1906 —Prof R Meldola, F R S, president, in the chair —A new laboratory method for the preparation of hydrogen sulphide F R L **Wilson**. If a current of hydrogen sulphide is passed over calcium hydroxide a hydrosulphide is formed which can be decomposed by carbon dioxide, a carbonate being produced and hydrogen sulphide evolved —The affinity constants of aminocarboxylic and aminosulphonic acids as determined by the aid of methyl-orange V H **Veley** It is shown that the usual mathematical expressions hold good, namely, those of straight lines, $y=kx$ or $y=kx-b$, or logarithmic curves, $\log y=\log k+x\log a$ Acids which show irregularities in the Ostwald electric conductivity expression $\phi(k)=a^2/(1-a)V_r(a=\mu/\mu_\infty)$ likewise show similar irregularities in the methyl-orange method —Contributions to the study of the calcium phosphates, I, the hydrates of the calcium hydrogen orthophosphates H **Bassett**, jun The author's experiments show that, in all probability, dicalcium phosphate can only form one hydrate

namely, the dihydrate —Contributions to the study of the calcium phosphates, ii, the action of ammonia gas on the calcium hydrogen orthophosphates H **Bassett**, jun —Relation between chemical constitution and physiological action in the tropeines H A D **Jowett** and F L **Pyman**. The authors conclude that Ladenburg's generalisation, which asserts that mydriatic tropeines must possess a benzene nucleus and a fatty hydroxyl in the side chain, cannot be maintained, since it does not hold good in the cases of terebyltropeine or the lactone of *o*-carboxyphenylglyceryltropeine —Some derivatives of salicylic acid H A D **Jowett** and F L **Pyman** Descriptions of cinnamoylsalicylic acid, its methyl and ethyl esters, and quinine salt, and also 3 5-dichloroacetylsalicylic acid, are given —The addition of bromine to cinnamic acid and its esters Preliminary notice J J **Sudborough** and J **Thomas**. An account of experiments made to determine the velocity of formation of the bromides of this acid and certain of its derivatives is given —The optical and magneto-optical influence of ethenoid linkings attached to contiguous carbon atoms J W **Brühl** It has been shown by Sir W H Perkin that limonene, dipentene, and $\Delta^{3\ ^{(9)}}$-*p*-menthadiene exhibit a remarkable difference in magnetic rotation, the values of the last being much higher than those of the two former The author showed that this is due to the presence of two double linkings in the position —C C C C— in the molecule of $\Delta^{3\ ^{(9)}}$-*p*-menthadiene —A difficulty in the theory of valency of W Barlow and W J Pope D L **Chapman** It is shown that the two propositions regarding the assemblages of spheres made by Messrs Barlow and Pope imply that a sphere of any size can replace any other without any resort to re-marshalling being necessary, and therefore cannot be used in their present unqualified form to demonstrate that valency is a simple volume relation —The more exact determination of the densities of crystals Earl of **Berkeley**. A conical pyknometer with thermometer stopper and graduated side-tube is used, and the evaporation of the liquid is relied on to bring the level in the capillary side-tube within the graduations The liquid used is carbon tetrachloride —A relation between the volumes of the atoms of certain compounds at the melting points and their valencies Interpretation by means of the Barlow-Pope theory G **Le Bas**. The molecular volumes of complex paraffins and alcohols can be calculated very exactly by means of the formulæ

$$\text{M V of } C_nH_{2n+2} = (6n+2)S = 6nS + 2S,$$

and

$$\text{M V of } C_nH_{2n+1}OH = (6n+4)S = 6nS + 4S,$$

where S is a constant which has an average value of 2 970, and is called the unitstere —The action of acid chlorides on thioureas A E **Dixon** and J **Hawthorne**. —3-Hydroxyphthalic and 3-methoxyphthalic acids and their derivatives W H **Bentley**, Miss R **Robinson**, and C **Weizmann** —4-Hydroxyphthalic and 4 methoxyphthalic acids W H **Bentley** and C **Weizmann** —Derivatives of naphthacenequinone W H **Bentley**, A **Friedl**, F **Thomas**, and C **Weizmann** —Dithioxanthoxalanil (preliminary note) S **Ruhemann**

PARIS

Academy of Sciences, December 31 1906 —M H Poincaré in the chair —M H Becquerel was elected vice-president for the year 1907 —Self-recording apparatus for the solar atmosphere H **Deslandres**. After giving an account of the essential conditions of the problem, the author discusses in detail the various methods possible, mentioning those already applied in different observatories It is pointed out that the more modern patterns differ both in movements and dimensions from the older forms Five diagrams accompany the paper —The observations of nebulæ made at the Paris Observatory G **Bigourdan** —A method of measuring the resistance opposed by metals to rapid deformations P **Vieille** and R **Liouville**. A law connecting the deformations of crushers used in ballistic experiments in the two cases—slow deformations, as in calibration, and deformation at varying velocities —A butyric lactone and unsymmetrical dimethyl-butylene glycol Louis **Henry** Butyrolactone, treated with magnesium methyl bromide or iodide, gives the glycol

$$(CH_3)_2(OH)—CH_2—CH_2—CH_2\,OH,$$

in about 50 per cent yield The glycol reacts with acetyl chloride, giving the chloroacetin

$$(CH_3)_2—CCl—CH_2—CH_2—CH_2Ac$$

—The conductibility accompanying the expansion of gases L **Bloch** The electrical effects due to the expansion of compressed air and oxygen are comparable, both being due to ions of fairly large mobility present in practically equal amounts The effects are very irregular, and the mean of a large number of experiments is required to obtain trustworthy results —Remarks on the thermodynamics of non-homogeneous mixtures Emil **Bose**. The Duhem-Margulès equation may be deduced in a simple manner from a formula given by Nernst for the thermal effects of the mixture of two liquids The author applies this to the case of two non-miscible liquids —A new manganese silicide G **Gin**. The new silicide has been obtained by the reduction of rhodonite in the electric furnace The composition corresponds to the constitution Si_2Mn_3 Its physical and chemical properties are described —The solubility of carbon in manganese sulphide M **Houdard**. Carbon dissolves in fused manganese sulphide in quantity proportional to the time of heating, the maximum solubility being 3 2 per cent The carbon is recovered from the ingot in the form of graphite it being indifferent whether amorphous carbon or diamond is originally added The manganese sulphide is not reduced —The density of gaseous hydrochloric acid, the atomic weight of chlorine Ph A **Guye** and G **Ter-Gazarian** An outline is given of the methods adopted for obtaining the gas in the pure state and measuring its density The mean weight of a litre of HCl at 0° C, under one atmosphere pressure, latitude 45°, at the level of the sea is 1 6398 grams The molecular weight of the gas has been calculated by the method of reduction to 8° C of the critical elements The atomic weight of chlorine thus derived is 35 461 agreeing well with the figure of Dixon and Edgar (35 463) or the value (35 460) deduced from the ratio Ag Cl for Ag (107 89) As the experiments are preliminary, the authors do not wish to lay too much stress on the exactitude of the coincidence —The melting points of the homologous hydrocarbons of the methane series D E **Tsakalotos** An empirical formula is given by means of which the melting points of the hydrocarbons between $C_{16}H_{34}$ and $C_{60}H_{122}$ have been calculated The agreement between the figures thus calculated and those actually observed is, with one exception, very close, the deviations being less than the experimental error —The study of the influence of radicals on the character of the complementary valencies of oxygen M **Tchelinzef** An experimental study of the thermal changes which take place on the addition of one or two molecules of ether to various organomagnesium compounds in benzene solution —The condensation of hydrazines with acetylenic nitriles A general method for the synthesis of the pyrazolonimines Ch **Moureu** and I **Lazennec** Hydrazines combine directly with acetylenic nitriles, and it is shown that the resulting compound is cyclic most probably a pyrazolonimine The reaction is general, and several examples are given of its application The transposition o hydrobenzoin study of the alkylhydrobenzoins and s e trisubstituted aromatic glycols MM **Tiffeneau** an **lorloncourt**.—The disease causing bitterness in wines **Trillat**. Evidence is given in support of the view th he bitterness in wine is due to the presence of an a yde resin —The cultural changes brought about in t oers of Solanum Edouard **Heckel** An account of the effects produced on several wild species of Solanum by excessive manuring —Some attempts at grafting in the Solanaceæ Ed **Griffon** In the experiments described grafting has had no specific morphological influence on either the graft or the plant —The production of a new variety of maize by traumatism L **Blaringhem** Mutilation constitutes a very powerful means for determining sudden variations, both hereditary and progressive in plants —Researches on the cultivation of asparagus in the Auxerrois Eug **Rousseaux** and Ch **Brioux** The existence of lymphoid formations producing blood cor-

pustles in the Gammaridæ L **Bruntz** —A new antelope from Central Africa, *Cephalophus leopoldi* Maurice **de Rothschild** and Henri **Neuville** —The influence of a small quantity of the radium emanation on the development and metamorphosis of batrachians P **Wintrebert**. —A comparison of sleep during the day and night N **Vaschide** Sleep during the daytime is in all cases less profound less restful, and less refreshing than sleep during the night —The treatment of malignant pustule by iodine A I **Llobet**.—The *charriage* of the northern slopes of the Pyrenees between the valley of Ariège and Roussillon' Léon **Bertrand** --Some early experiments of M Daubrée and of M de Chancourtois relative to the artificial imitation of mountain chains Stanislas **Meunier**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 10

MATHEMATICAL SOCIETY, at 5 30 —Exhibition of Four-dimensional Models Mrs A Stott —On the Uniform Convergence of Fourier's Series Dr E W Hobson —Asymptotic Approximation to Integral Functions of Zero Order J E Littlewood —Partial Differential Equations of the Second Order having Integral Systems free from Partial Quadratures Prof A R Forsyth —On the Singular Points of Some Classes of Power Series in Several Variables G H Hardy.—The Construction of the Line drawn through a Given Point to meet Two Given Lines Prof W Burnside. - On the Reducibility of Covariants of Binary Quantics of Infinite Order, Part III P W Wood —On Hypereven Numbers, and on Fermat's Numbers Lieut. Col A Cunningham

INSTITUTION OF ELECTRICAL ENGINEERS, at 8 —New Incandescent Lamps J Swinburne

FRIDAY, JANUARY 11

INSTITUTION OF CIVIL ENGINEERS, at 8 —The Balancing of Internal combustion Motors applied to Marine Propulsion A T Weston

ROYAL ASTRONOMICAL SOCIETY, at 5 —Observation of the Occultation of Saturn by the Moon 1906, October 27 John Tebbutt —The Places of Zodiacal Stars for the Epoch 1900 A M W Downing —The Perturbations of Halley's Comet P H Cowell and A C D Crommelin.—Micrometrical Measures of Double Stars Rev T E Espin —New Double Stars Rev T E Espin —Observations of Occultations of Stars by the Moon made in the Year 1906 Royal Observatory, Greenwich — *Probable Paper* Mean Areas and Heliographic Latitudes of Sun-spots in the Year 1905, Deduced from Photographs taken at the Royal Observatory Greenwich, at Debra Dûn at Kodaikanal Observatory, India, and in Mauritius (communicated by the Astronomer Royal) —*Probable Discussion* Prof Fowler's Papers on the Enhanced Lines of Iron in the Region F to C, and on Silicon in the Chromosphere

MALACOLOGICAL SOCIETY, at 8 —Descriptions of New Species of Achatina from the Congo Free State S I Da Costa.—Further Contributions to the Genus Chloritis, with Descriptions of Eleven New Species G K Gude —Description of a New Species of Papuina, and Illustrations of some hitherto unfigured Helicoid Land shells G K Gude.—Descriptions of new Non marine Shells from New Zealand Henry Suter

SATURDAY, JANUARY 12

ROYAL GEOGRAPHICAL SOCIETY (at The Queen's Hall, Langham Place), at 8 45 —The Duke of the Abruzzi's Expedition to Mount Ruwenzori

PUBLIC SCHOOL SCIENCE MASTERS ASSOCIATION (University of London), at 2 30 —The Place of Science and of Literature in a General Education Rev and Hon E Lyttelton —The Internal Economy of School Science Mr Thwaites.—The best Method of Introducing the Atomic Theory in Science F R L Wilson

MONDAY, JANUARY 14

LONDON INSTITUTION, at 5 —The Wonder Workers of the Soil Prof W B Bottomley

TUESDAY JANUARY 15.

ROYAL INSTITUTION at 3 —The Sculpture of Aegina in Relation to Recent Discovery Prof Percy Gardner

ZOOLOGICAL SOCIETY, at 8 30 —On a Collection of Mammals made by Dr Vassal in Annam J Lewis Bonhote —On the "Bleating or 'Drumming of the Snipe (*Gallinago coelestis*) P H Bahr —Some New and Insufficiently known Species of Marmoset Monkeys from the Amazonian Region Dr F A Goeldi —Contributions to the Knowledge of the Systematic Arrangement and Anatomy of Certain Genera and Species of Squamata F E. Beddard, F R S

ROYAL STATISTICAL SOCIETY, at 5

SOCIETY OF ARTS at 4 30 —The Progress of the Uganda Protectorate George Wilson, C B

FARADAY SOCIETY, at 8 —The Application of the Electron Theory to Electrolysis E. E Fournier d Albe.

WEDNESDAY, JANUARY 16

SOCIETY OF ARTS, at 8 —Adjourned Discussion on Mr J W Gordon's Paper, Patent Law Reform

ROYAL MICROSCOPICAL SOCIETY at 8 —President's Annual Address, The Flowering Plants of the Mesozoic Age in the Light of Recent Discoveries.—Exhibition of Mounted Specimens of Freshwater Polyzoa Mr Rousselet

METEOROLOGICAL SOCIETY, at 7 45 —Annual General Meeting —Presidential Address, Weather in War Time Richard Bentley.

THURSDAY, JANUARY 17

ROYAL SOCIETY, at 4 30.—*Probable Papers*: Regeneration of Bone, Part iii: Sir William Macewen, K C B, F R S —Further Observations on the Effects Produced in Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness H G Plimmer —The Natural and Induced Resistance of Mice to the Growth of Cancer Dr E F Bashford, J A. Murray, and Dr W Cramer —On the Pathology of the Dropsy produced by Obstruction of the Superior and Inferior Venæ Cavæ and the Portal Vein, Preliminary Communication Dr C Bolton.—Experiments on the Dark Space in Vacuum Tubes Sir William Crookes, F R.S —On the Discharge of Negative Electricity from Hot Calcium Dr F Horton.

CHEMICAL SOCIETY, at 8 30.—The Relation between Absorption Spectra and Optical Rotatory Power, Part I, The Effect of Unsaturation and Stereo isomerism A W Stewart —Organic Derivatives of Silicon, Part ii, The Synthesis of Di-ethyl, Propyl Benzyl Silicol, its Sulphonation, and the Resolution of the Sulphonic Derivatives into Optically Active Compounds F S Kipping —The Association of Phenols in the Liquid Condition J T Hewitt and T F, Winmill.—A New Mercuric Oxychloride J T Hewitt —Aromatic Selenonium Bases S. Smiles and T P Hilditch —The Relation of Colour and Fluorescence to Constitution A. G Green —The Constitution of Silver Nitrite, a Correction E Divers —Preparation of Chromyl Chloride F D Law and F M Perkin —Tetraketopiperazine A. T de Moulpied and A. Rule

ROYAL INSTITUTION, at 3.—Recent Advances in the Exploration of the Atmosphere Dr W N Shaw, F R S

LINNEAN SOCIETY, at 8 —*Platanthera chlorantha*, Custor, var *tricalcarata* W Botting Hemsley, F R.S.—Acanthaceæ of Insular Malaya the late Mr C B Clarke, F R S —A Freshwater Isopod from Calcutta Rev T R R Stebbing, F R S

FRIDAY JANUARY 18

ROYAL INSTITUTION, at 9.—Fifty Years of Explosives Sir Andrew Noble, Bart, K C.B, F R S

INSTITUTION OF MECHANICAL ENGINEERS, at 8 —Adjourned Discussion on Lighting of Railway Premises, Indoor and Outdoor H Fowler — Eighth Report to the Alloys Research Committee On the Properties of the Alloys of Aluminium and Copper Prof H C H Carpenter and C A Edwards

CONTENTS.

THURSDAY, JANUARY 17 1907

SOCIAL PROBLEMS IN AMERICA

The Future in America—a Search after Realities By H G Wells Pp 359 (London Chapman and Hall, Ltd) Price 10s 6d net

WE opened this book fearing that like other books by the same author it was an attempt to extrapolate or foretell the future from a mere man's quite inadequate knowledge of the present and the past, but we have been delightfully disappointed Mr Wells is acute in observation he is well informed on English social problems and he reasons carefully His visit to America was very short but it was preceded by much reading He nowhere speaks dogmatically, he evidently restrains his inclination to draw general conclusions from a sense that he may be neglecting important premises and such conclusions as he comes to seem to us to be sound and of value

Americans have never been tolerant of outside criticism even when it was obviously honest and good yet surely it is needed and is found useful by other nations Never was an outside critic more kindly and sympathetic than Mr Wells and we have no doubt that during the next twenty years this book will be referred to and quoted from by every good writer on social problems which after all are not peculiar to America The American people are like the middle classes of England France and Germany there is no feudal or aristocratic upper class there is no earth tied peasant The American idea is the middle-class idea everywhere but in America it has been carried out without restrictions it fosters that kind of individuality which thrives on open and undisciplined competition for wealth

And the time is coming when the American formula will no longer suffice Settled conditions and great possibilities of wealth given by nature to a large middle class kind of population have produced their natural effects The compound interest law of increase of wealth is in action and gigantic fortunes in the hands of quite common men have not only destroyed the idea of equality but have become a danger to the community Every energetic worker feels that there are limitations now being put to his chances of getting on It is possible quite legally for rich individuals to further their schemes by widespread corruption Corruption everywhere but especially in municipal governments has assumed such large dimensions that it seems impossible to remedy the evil The average man attends to his own personal affairs and has no sense of his duties as a citizen He resents all Government interference Indeed it is part of the American formula that the cultured and rich men and one may say the best men take no interest in Imperial or State or municipal affairs—to touch pitch is to be defiled—and that the ordinary citizen thinks only of his own interests in this world and the next Immigration is no longer British and Teutonic The German and Russian Jew, the lower classes from Austria and Italy and Turkey are—nearly one million of them a year welcomed as necessary recruits in the serf army of the capitalists In this serf army the children and women are the chief sufferers No story told of an old Lancashire factory can compete with some of the horrors of New Jersey at the present time

There has always been in America a widespread contempt not for the law but for abstract justice so that even well minded influential people do not set themselves to remedy obvious wrong when by so doing they might hurt themselves or their party in the eyes of multitudes of base and busy greedy and childish malevolent and ignorant voters The unfairness of the southerner to the negro is no longer confined to the south and the crimes of a few negroes exasperate white people so much that they forget the kindly ways of the average man of colour and thus the negro question is becoming more complex

But thoughtful Americans are already feeling the inadequacy of their old formulas New ideas are organising themselves out of the little limited efforts of innumerable men Many universities are busy on the study of social problems The younger generation is already raising an opposition to the tyranny of mere industrialism by cultivating religious philosophic literary scientific artistic and political thought and they are doing this not as a mere matter of taste but in their sacred duty as citizens

One of the most interesting chapters in this book is entitled Culture If it were possible to get Boston to read anything of recent date the perusal of this chapter would produce a much needed revolution there Between that Scylla the fervid ignorance of the workers of Paterson and that Charybdis the prestige and mere knowledge and genteel aloofness and culture which make Boston useless the creative minds of the university reformers must steer their dangerous way At futile Washington Mr Wells found a real man the anxious perplexed President who is a microcosm of his hundred million subjects who sees all that is wrong and the difficulty of reform Mr Roosevelt assimilates all that makes for reform in contemporary thought and causes it to reverberate over the land so that it becomes familiar to all people At the root of all reform is political reform creating a legislature at Washington and an executive which shall be in harmony with one another and which under proper safeguards shall be able to put aside the present obstruction of the various States Only a great educated and sustained agitation can bring about such a revolution

Mr Wells would almost leave us still in doubt may not America after all be a great futility But just at the very end we find him optimistic We are inclined to think that Mr Wells pays too much attention to America of the present and that if he thought more of America of the past he would be altogether optimistic Mrs Trollope and Cooper and Dickens differed but little in opinion and can any candid student of their writings deny that America

it is surmounted social difficulties which looked almost insuperable sixty years ago? What Mr Wells says is all true, but there is also much more to be said The average American neglects politics and selfishly thinks of his own interests, yes, but every now and again he shows himself capable of the highest kind of self-sacrifice At the back of the futile Boston culture is the spirit of Charleston Neck and Bunker's Hill, and the cultured Bostonian had this great merit, he saw that Abraham Lincoln could save the country We consider that the worst thing in America is Philistinism, commonness or vulgarity of thought, the great merit of Boston is that she has always combated this Then, as to immigration, we believe that an intermixture of all the European races (and, if we could only get it, an assimilation of the Jews) would produce the very finest nation ever known These lower races of whom Mr Wells speaks are a danger only for a time, in the second and later generations their presence will be shown in a better appreciation of music and literature and painting

The supreme danger to any State lies in the diminution of its middle class, this is the greatest lesson of history We see no chance of such a diminution in America for a very long time to come Furthermore, there is an evident growing determination in this middle class that social problems shall be solved at whatever cost Lynching is altogether evil, but it occurs only in certain parts of a country of enormous size still nearly empty of inhabitants, it certainly is altogether against the spirit of the American people, one of whose strongest characteristics has always been a respect for *law* It was a product of the slave system, and is diminishing

The Europeanised American who scorns politics is truly a curse to himself and his own country and to Europe, but there is now a new revelation Mr Roosevelt is not the only rich, educated American who has conquered his fear of touching pitch We agree with Mr Wells as to the inferiority of American school education, the root of all evils, but the sole cause of this is poor payment for teachers, and, like many another great mischief in America may be altered almost by the stroke of a pen Has not universal spitting, the habit most dreaded by Dickens, disappeared in one half-year? Anything in the way of quick reform is possible in a country like America, where everybody reads, and where the cheapest monthly magazines, published by millions, contain serious articles about the great American problems and reforms, where in all States north of the Washington parallel the people resemble the Scotch, that is, even the commonest labourers are accustomed to abstract reasoning because of their early religious education We cannot doubt that it will work out triumphantly its own and our salvation, for it is to be remembered that all the insoluble-looking problems of America are coming for solution more slowly upon England and France and Germany We believe that Mr Wells has done something important towards solving such problems, and it is not merely America that ought to be grateful to him

JOHN PERRY

NAVAL CHEMISTRY.

Service Chemistry a Short Manual of Chemistry and its Applications in the Naval and Military Services. By Vivian B. Lewes and J S. S. Brame. Third and revised edition Pp. xvi+678 (London: Henry Glaisher, Greenwich J. Glaisher, 1906.)

THIS book was primarily designed for the use of officers passing through the Royal Naval College, Greenwich, who while requiring to know something of the practical applications of chemistry to their profession if they are to carry out its multifarious duties intelligently and efficiently, have only a very limited amount of time to give to the study of the science The naval officer nowadays is confronted with conditions which were absolutely unknown to and undreamt of by those who were placed in charge of our old "wooden walls" Steam and steel and high explosives have completely revolutionised the navies of to-day, and modern men-of-war are the embodiment of the most advanced developments of mechanical, physical, and chemical science He who would handle these costly creations to the best advantage needs to have acquaintance with the scientific principles upon which their construction, maintenance, and effective employment depend, and what intelligent handling means, and what momentous issues may depend upon it was demonstrated in a manner which profoundly impressed the whole world in the ever-memorable battle of the Sea of Japan That object-lesson has given rise to much heart searching on the part of every maritime Power Whether we are bettering the example of our Eastern ally—whether, indeed, we are really following it—is a matter which gravely concerns this nation It would, of course, be out of place in this connection to discuss the various factors upon which the astonishing success of Japan depended, patriotism, courage, the spirit of self-sacrifice, discipline, intelligence, and integrity—in a word, what we understand by *moral*—were no doubt at the bottom of it all But these qualities alone might have availed little unless supplemented by skilful direction of the machinery and appliances of which our modern engines of destruction are built up, and skilful direction depends upon an intelligent appreciation of the scientific principles underlying the construction and efficient use of these appliances The rulers of rejuvenated Japan had clearly grasped this fact, and it cannot be questioned that it is to the manner in which they have given practical effect to this recognition in the training of their naval and military leaders, even during the short space of a generation, that their supremacy in the East is mainly due.

There is, of course, much in chemistry which in no conceivable circumstances can have the slightest professional interest to the naval man, and which, therefore, it would be useless and a waste of time to trouble him with

But every naval officer is the better for knowing something, for example, of the causes of corrosion and fouling of ships, of the nature of boiler incrustations, of the properties and composition of various forms of fuel; of the chemical characters of explosives,

&c., and it is precisely to matters like these that Prof Lewes's scheme of instruction is mainly directed How to develop such a scheme on scientific lines under the conditions and limitations which have necessarily been imposed upon the authors is a problem of no small difficulty That they have completely solved it in this book, even in the amended and extended form in which it now appears, they themselves would doubtless be the first to question At the same time, there is nothing in our language even approximately resembling it, and it still remains the only manual which deals exclusively with the chemistry of the special matters with which the naval officer is more immediately concerned

The present volume differs from its predecessors in many important points With the collaboration of Mr. Brame it has been largely re-arranged and in great part re-written, and care has been taken to embody the latest information so far as this was available to the authors

The theoretical part is necessarily very restricted Indeed, it is obvious that the philosophical aspects of chemistry have hardly more attraction for the authors than they have for the special class to whom the book is addressed This, of course, is one of the difficulties of the problem It is of no practical use to teach chemistry to naval officers as if they were going to be professional chemists, and the authors have therefore wisely confined themselves in the main to such theoretical aspects of the science as are related to the matters with which naval men are directly interested.

Naturally the applications of theory are constantly extending, and what is "theory" to-day becomes "practice" to-morrow—a truism of which the authors, it must be added, are not unmindful, for imperfect and partial as their treatment of doctrinal questions may be, it is probably sufficient for such developments as are likely, at all events in the near future, to occur

In one respect the book differs very materially from the ordinary run of chemical text-books, namely, in the large amount of original information it conveys Prof Lewes's official connection with the Admiralty has necessarily caused him to pay special attention to chemical matters of importance to the service, and many of the results of his inquiries, some of which, indeed, are the outcome of prolonged investigation, are summarised in his manual. Although, as stated, it is primarily intended for the naval officer, there is much in the work which is of equal interest to the military man and to the practical engineer

We have noticed one or two errors, but they are of minor importance Silicon was first isolated by Berzelius in 1823, and not, as stated, by Davy in 1813. There is no such thing as P_2O_3, phosphorous oxide has the formula P_4O_6, just as its analogue arsenious oxide has the formula As_4O_6 The description of the mode of manufacture of the lucifer match hardly corresponds with modern practice, white phosphorus is rarely used in the "strike-anywhere" match to-day; it has been almost wholly replaced by phosphorus sesquisulphide

FORMATION OF ICE ON THE ST LAWRENCE.

Ice Formation, with Special Reference to Anchor-ice and Frazil By Howard T Barnes Pp. x+260 (New York John Wiley and Sons, London: Chapman and Hall, Ltd.) Price 12s 6d net

THE effects of the severe Canadian winters on such a large river, with a variable flow, as the St Lawrence afford remarkable opportunities for studying the phenomena of ice formation, which the author has availed himself of during the last ten years, and this book records the results of his observations and the conclusions he has drawn from them Moreover, in order to render the account of his investigations on ice formation more complete, he has introduced the subject with three chapters, on the "Physical Laws governing the Transfer of Heat," "Physical Constants of Ice," and "Formation and Structure of Ice," and has added towards the end a chapter on previous "Theories to account for Frazil and Anchor-ice," which would more suitably have preceded the exposition of his own views in the fourth chapter Lastly, in the final chapter, the author gives a practical application to his investigations by indicating the causes which, in severe winters, are liable to occasion the stoppage of water-power works, and suggesting measures by which accumulations of ice at critical points, tending to arrest the flow of water, may be reduced

Three forms of ice are found in the St Lawrence in winter, namely, sheet- or surface-ice, frazil-ice, and anchor-ice, differing in their mode of formation, their general appearance, the position they occupy in the river, and the effects which they produce Sheet-ice is the well-known form of ice which, when the temperature falls below the freezing point, gradually forms on the surface at the sides of a sheet of still water, spreads out into deeper water if the cold continues, and increases slowly in thickness Frazil-ice is the French-Canadian term signifying cinder-ice, for a peculiar spiky form of ice supposed to resemble cinders, which is formed on the surface in open channels where the current is too rapid for the border-ice to extend across them, and this ice which is sometimes called slush-ice varies in its formation according to the amount of agitation of the water, appearing as flat plates on the smooth surface of a current, or as numberless minute needles in rapids and at the base of waterfalls These needles of ice increase in bulk in traversing open water for some distance, and eventually fill up the open channel during the prevalence of great cold and strong winds often experienced in Canadian winters This fine ice is often carried by the current a long way under surface-ice which has formed lower down, and, becoming attached to the under-side of this sheet, and gradually accumulating and becoming consolidated, it is liable to dam up the channel completely down to observed depths of 80 feet, and, consequently, raise the level of the river considerably above

Anchor-ice, as it is called in Canada, and known as *glace-du-fond* in France and *Grundeis* in Germany, has been long observed in most countries where ice

forms in rivers, and is the term applied to ice formed on and attached to the bottom of rivers. This anchor-ice is only formed in rivers where the current is too swift for surface-ice to form, and not in depths exceeding 40 feet to 45 feet, though in the clear sea-water off the coast of Newfoundland it is largely formed at depths of 60 feet to 70 feet. Its formation appears to be rightly attributed to loss of heat in the bed of the river from radiation, for it occurs on clear, cold nights, and is impeded by any form of shelter interfering with radiation, such as under a bridge, it does not form at all under surface-ice arresting radiation, and is less below a turbulent river than in a clear, still sea. Frazil-ice is the cause of the packing up of the ice and of the floods of the St. Lawrence, and also of the obstruction to the working of the power plants in the winter. When a river is completely frozen over, the channel is protected from the formation of frazil-ice or anchor-ice, unless there is an expanse of open water above, from which frazil-ice, and in mild weather anchor-ice, is carried down. To prevent the stoppage of the power works in the latter case, the author suggests that the gates, the rack for arresting débris, and the wheels should be placed under shelter, that the iron bars of the rack should be heated, and that the passage of the frazil-ice should be facilitated as much as possible, and prevented from agglomerating by the occasional injection of steam.

ROMANTIC INDIA

Under the Sun. Impressions of Indian Cities. By P. Landon. Pp. xii+288, illustrated. (London: Hurst and Blackett, Ltd., 1906.) Price 12s. 6d. net.

THIS is one of the crop of books on India by Press correspondents who visited the great Eastern dependency during the recent tour of the Prince of Wales. Its author had previously on one or two occasions spent some weeks in the country, and now presents part of his already published letters "recast in a more permanent form." It is perhaps inevitable that the great bulk of the impressionist literature on the East should issue from the hurried pens of the cold-weather globe-trotters, whose "butterfly zigzags" over the country undoubtedly enable them often to see things from fresh and comparative, if somewhat superficial, standpoints. With all India to roam over, it would be surprising did the oft told tale of Indian cities not bear some repetition at the hands of such an imaginative journalist as Mr. Landon. He certainly has produced a readable book, though many of his sketches convey less clear-cut impressions of the places than those of some other writers who have gone over the ground before, Steevens, for instance, and they lack proportion. Some point is seized on and overstrained with a discursiveness that causes the reader at times to lose the thread of the narrative, whilst other more characteristic features of the picture are omitted.

The author betrays a weakness for unnecessarily dragging in vernacular names (some of which are misspelt, *e.g.* "bebel," which occurs a dozen times for "bābul," the *Acacia arabica*), with no word of explanation to the reader as to what the thing is, and his too frequent use of superlatives leads him into meeting the most transcendental thing "on earth" many times on his trip. Thus we are told within a hundred pages that at Udaipur "one room is without rival on earth." The Indian antelope and cheetah are "two of the fastest animals on earth—the cheetah is beyond all question the swiftest." Jaipur has "colours that only Mandalay of all places in the world can hope to rival." A "dishonest and fugitive jeweller from France" is "the first decorator of all known periods." The Delhi grand trunk-road is "the most historic highway in the East." Although the Taj is "the crown and goal of all that India has of beauty and romance," the Queen's monastery at Mandalay is "the most picturesque place in the East, probably in the world," though a few pages previously we read that the Shwe Dagon pagoda at Rangoon also is "the most picturesque place in all the East."

As to details, he is not over careful; he speaks of bread-fruit "palms," and of the reedy banks of Calcutta "flaming with patches of rose lotus"—this might be the case if lotuses grew on banks, but they do not. At Darjiling, he says, "the valley stretches out ten miles wide from the foot of the precipice"; as a fact, the valleys there are narrow ravines, none of which has a width of more than a quarter of a mile at its bottom. The photographs of the hackneyed views one has so often seen before are good and well reproduced; the same, however, cannot be said for the coloured prints, which are unpleasantly low-toned from a too liberal application of dull paint; the sombre view of "the sunset glories of the Hugli" is utterly unlike what it is meant to represent.

A chapter is added on the later life of the notorious rebel and fugitive of Mutiny days, Nana Sahib, purporting to give "historical facts here presented for the first time." No one, however, can seriously be expected to accept as evidence the old re-discovered bazaar rumours picked up by a passing traveller and set down without absolutely any proof whatever in support of them, all the more so as such an experienced Anglo-Indian magistrate as Sir Dennis Fitzpatrick, commanding the resources of the Imperial secret police, was specially deputed to sift such rumours at the time, and finally rejected them as wholly unfounded. There is no index, but this, perhaps, is unnecessary for fugitive sketches.

OUR BOOK SHELF

Species and Varieties. Their Origin by Mutation. Lectures delivered at the University of California. Second Edition, Corrected and Revised. By H. De Vries, edited by D. T. MacDougal. Pp. xviii+847. (Chicago: Open Court Publishing Co.; London: Kegan Paul and Co., Ltd., 1906.)

IT is not surprising that the first edition of De Vries's lectures in America should be followed by a second after the lapse of a year. All the misprints that we pointed out in our review of the first edition have been corrected, and even our suggestion that uniformity in the termination of the adjectives derived from such terms as physiology was

desirable has been adopted But, curiously enough, the uniformity is intra-verbal and not inter-verbal, for whilst the physiologics and physiologicals of the first edition appear as physiologics in the second, and whilst the same course has been followed with the adjectival forms of morphology and palæontology, the empirics and empiricals of the first edition appear as empiricals in the second We condemn the manner in which this uniformity has been introduced We are perfectly aware that morphologic is correct, and that morphological is hybrid and redundant, containing as it does a Greek and a Latin adjectival termination, but we hold that the former is ugly and that the latter is not If the customary termination is allowed in the case of empirical, on what grounds is it refused in that of physiological? If in our choice of the forms of terms we have to choose between those with the meaning and sound of which we have become familiar, be they never so hybrid, and those forms of them that we are told are strictly logic, let us by all means choose the former

There is no need to commend the book It is indispensable, inasmuch as it is the only available account of Prof de Vries's work in English, so far

A D D

Time and Clocks a Description of Ancient and Modern Methods of Measuring Time By H H Cunynghame, C B Pp 200 (London Archibald Constable and Co, Ltd, 1906) Price 6s net

IN this volume the author has gone much further than the title and subtitle would lead one to expect Not only are the "ancient and modern methods of measuring time" discussed, but an attempt has been made to lead the non-scientific reader to a knowledge of the many principles involved in a series of logical steps Mass, gravity, space, harmonic motion, &c, &c, are all discussed at length, whilst excursions into the ancient concepts of various phenomena are by no means infrequent

We rather fear that the reader who has not gone through a course of dynamics will find it hard to grasp the significance of the various discussions, despite the clear reasoning and simple examples, whilst to the science student a greater part of the matter is unnecessary

Still, in the hands of a youth trained in the ideal fashion suggested by the author at the end of the book (p 186), the volume, carefully digested should prove of service and tend "to keep the young rascal from worrying his sisters and stoning the cat"

W E R

Conduction of Electricity through Gases By Prof J J Thomson, F R S Second edition Cambridge Physical Series Pp vi+678 (Cambridge University Press, 1906) Price 16s

THIS book, the first edition of which was fully noticed in NATURE (vol lxix, p 74), will be welcomed by all those who are striving to keep up with the rapidly growing literature of an increasingly important subject It was the author's researches in this field which first paved the way for the rapid extension of our knowledge which has taken place in the last few years Much still remains to be done before the innumerable phenomena encountered in the study of the electrical behaviour of gases can be considered fully elucidated, and to the thoughtful worker these still unoccupied regions will probably be the most attractive While this book has been waiting notice on the reviewer's table, frequent reference has been made to it for work that has appeared since the issue of the first edition, and in no case in vain It maintains in an enhanced degree its good qualities as a work of reference none engaged in the subject can be without, and as an authoritative exposition of a field of work the author has made his own it has its own place among a wide circle of readers.

The New Physics and Chemistry a Series of Popular Essays on Physical and Chemical Subjects By W A Shenstone, F R S Pp vii+360 (London Smith, Elder and Co, 1906) Price 7s 6d net

WHEN a collection of essays upon the chief problems in physical science engaging the attention of investigators at the present time is published without an index, its value to students of scientific progress is greatly diminished Mr Shenstone evidently does not intend the book to be used for reference, otherwise he would have provided a key to its contents His essays, which originally appeared in the *Cornhill Magazine*, represent popular science at its best, and rehearse the outstanding features of the new physics and chemistry in a style easy of comprehension The book should serve a useful purpose in revealing to readers familiar with the concepts of physical science the richness of fact and theory relating to the properties and constitution of matter and the ether

The Manufacture of Light By Prof Silvanus P Thompson, F R S Pp vi+67 (London Macmillan and Co, Ltd, 1906) Price 1s net

PROF THOMPSON'S evening lecture delivered at the York meeting of the British Association in August last is here presented in an attractive form Twenty-eight clearly reproduced illustrations assist greatly in a thorough comprehension of the discourse After a brief description of primitive sources of light and a reference to the inventions of gas and electric lighting the general question of incandescence is discussed This is followed by an account of photometry and an explanation of the inequality in different directions of the light from various sources After dealing with the sensitiveness of the eye to radiations of particular wave-lengths, the measurement of emission, and the temperature and quality of radiation, Prof Thompson describes various incandescent gas-lights, new kinds of glow-lamps and arc-lamps, and concludes with a consideration of the cost of the manufacture of light The little book should have a wide popularity

Lichtstrahlung und Beleuchtung By Paul Hogner Pp ix+66, illustrated No 8 of Dr G Benischke's "Elektrotechnik in Einzel-Darstellungen" (Brunswick Vieweg and Son, 1906) Price 3 marks

THIS book gives a clear exposition of illumination by means of electric arc lamps The theory of the subject is well set forth and starts from a sufficiently elementary foundation to be easily followed by the average student The chief feature of the work is a number of tables giving data concerning illumination under different conditions and these might be profitably consulted by those wishing to arrive at the best results in a given case The book is well printed and the diagrams are good

A Synonymic Catalogue of Orthoptera Vol ii, Orthoptera Saltatoria, Part i (Achetidæ et Phasgonuridæ) By W F Kirby (London Printed by Order of the Trustees of the British Museum, 1906) Price 15s

THIS volume is the continuation of Mr Kirby's synonymic catalogue the first part of which was published in November, 1904 The present work includes the Achetidæ, or crickets, and the Phasgonuridæ or long-horned grasshoppers, often improperly called Locustidæ The true Locustidæ or short-horned grasshoppers—often called Acrididæ—will form the third and concluding volume of this work

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Production of Radium from Actinium

IN a recent letter to this Journal (November 15, 1906) Dr. Boltwood has given an account of experiments which show that radium is continuously produced in a solution of actinium, and concludes that radium is a disintegration product of actinium, the latter occupying an intermediate position in the family of disintegration products between uranium and radium. The radium is produced from the actinium at about the theoretical rate, and he deduces in a simple way that the time for radium to be half transformed is about 3000 years. These results of Dr. Boltwood are of great interest, and mark an important stage in the search for the somewhat elusive parent of radium.

It may be of interest to the readers of NATURE to give a brief account of some experiments I have made on this subject, the results of which were communicated to the American Physical Society at New York on December 28, 1906. In the Bakerian lecture of 1904 (Phil. Trans., A, p. 169, 1904) I briefly described some experiments that had been commenced to see whether actinium produced radium. Some of Giesel's actinium was taken, dissolved in acid, and the greater part of the radium then present was removed by precipitating barium in the solution. The amount of radium left in the solution was determined by the emanation method, using an electroscope carefully calibrated by means of a standard radium solution. Over a period of three months no very certain evidence was obtained that the amount of radium had increased. The solution of actinium was then set aside in a closed vessel with the intention of testing it for the presence of radium at regular intervals. In the meantime, the great danger of possible contamination, in testing solutions for radium in a laboratory where considerable quantities of radium were continually in use, was recognised, and for this and other reasons the solution was not again tested until two and a half years had elapsed.

When Dr. Boltwood informed me of the growth of radium in his actinium, I at once tested this solution for radium by the emanation method. A preliminary observation showed that there had been a large increase in the quantity of radium in the solution in the interval since the early experiments. In the course of making an accurate determination, the solution was unfortunately contaminated with radium, probably through the use of a lubricant on a stop-cock attached to the vessel. Under such conditions I could place no reliance on the final measurement. Happily, however, I had placed aside, at the time of preparing the original actinium solution, a sample of the actinium salt the radium content of which at that time had been accurately determined. This was now tested, and the amount of radium in it was found to have increased at least four times the initial value in the two and a half years' interval, showing a rate of growth of radium in the actinium of much the same magnitude as that observed in the experiments recorded later. I think that my failure to observe an increase in the amount of radium in the actinium solution over a period of three months was due to the unsuitable chemical treatment used initially to remove the radium from the actinium. An excess of sulphuric acid must have remained in the solution, and this would tend to precipitate the radium when formed as sulphate—a condition in which probably only a fraction of the emanation would be released. A considerable increase in the amount of radium might consequently only show a small increase in the amount of emanation carried away by aspirating air through the solution.

Experiments were at once undertaken to remove the radium again from the contaminated solution by a simpler and better method. This proved successful, and only a minute fraction of the radium was left in the solution. The latter was then placed in a glass vessel, and the amount of radium in it determined weekly by boiling out the emanation, and then introducing it into a suitable emanation electroscope. A progressive increase in the amount of radium has been observed, amounting to 80 per cent. of the initial value over a period of five weeks. If this rate of growth continues at a constant rate, the amount of radium in the solution at the end of a year should be more than eight times the initial value. The actinium used in this experiment was equivalent to about half a gram of an actinium preparation of activity about 250 times uranium, and the rate of growth of radium observed corresponds to about 3×10^{-9} gram of radium per year.

There is one important point that suggests itself in considering the results as given by Dr. Boltwood. The growth of radium observed in his actinium solution possibly might arise, not from the actinium itself, but from another distinct substance, normally separated from the radioactive mineral with the actinium. In order to throw some light on this question, I compared the rate of production of radium observed in my actinium with the rate of production to be expected on the simple theory, supposing that the actinium is transformed directly into radium. Without going into details, it suffices to say that this can be done by comparing the α-ray activity of a known fraction of the actinium solution in the form of a very thin film with that of a thin film containing a known quantity of radium. In this way I calculated that the growth of radium observed agreed with the disintegration theory, if the period of half transformation of radium was about 2600 years. The period so deduced is not very different from that determined by Boltwood from quite distinct considerations. This is satisfactory so far as it goes, but such an agreement between the periods obtained by the two methods implies that the activity, due to the actinium in pitchblende, is about the same as that due to radium and its products. As a result of careful measurements, Boltwood, however, found that this is not the case, for the activity due to the actinium is only a small fraction of that due to radium. Further experiments are required to explain this anomaly.

There is one other point on which I have made a number of experiments. If radium arises from actinium, it should be produced by the active deposit of actinium which contains the last products of the actinium series, namely, actinium A and B. In order to test this, a platinum plate was made the negative electrode in a vessel containing a very active actinium preparation, and the active deposit was collected for a week or more. The platinum plate was then removed and immersed in a closed vessel containing dilute hydrochloric acid. After standing for a week, the accumulated emanation was boiled out, and the amount determined in an electroscope. Knowing the amount of the α-ray activity due to the active deposit on the platinum plate compared with the activity due to a thin film of radium, and also the time of exposure, it is a simple matter to calculate the growth of radium to be expected on the assumption that radium is half transformed in about 3000 years. Using a small platinum plate, the amount of radium observed was certainly not greater than one-tenth the theoretical amount, and, with a much larger plate not more than one-fifth. In these experiments the greatest care was taken to avoid any possible radium contamination. The observations were made in the chemistry building which is free from radio-active material, and I was fortunate in having the use of the emanation electroscopes of low natural leak, set up by Mr. Eve, who kindly assisted me in these experiments. The plates and solutions employed were initially tested for the presence of radium, so that the growth of radium observed, though much smaller than the theoretical amount, was still quite definite. These experiments are being continued. The smallness of the amount of radium observed may either be due to the presence of another change between actinium B and radium, or, what is more probable, to the loss in an electric field of the radium formed on the platinum plate. Such a possibility is suggested by the results of Meyer and Schweidler, who observed that there was always a small residual activity on substances, exposed for a long time in the presence of the actinium emanation, which gradually disappeared.

Further experiments are in progress to examine in the early stages the growth of radium in actinium, initially freed from radio-actinium and all its products If actinium changes directly into radium, the initial growth of the radium should be much smaller than that to be obtained three months later, when the products are in approximate equilibrium.

The results of my experiments are thus substantially in agreement with those of Dr. Boltwood There is no doubt that the immediate parent of radium is present in actinium separated from pitchblende, but certain points remain to be settled before it is definitely proved that radium is the direct lineal descendant of actinium Since the proof of this relationship between actinium and radium involves many important theoretical consequences, I think it is advisable to await the results of further experiment in this direction before basing far-reaching conclusions upon it.

E RUTHERFORD

McGill University, Montreal, January 3

Helium and Argon in Common Rocks

THE quantity of radium found in granites and kindred rocks (Proc Roy Soc, A, vol lxxvii p 472), about 10^{-11} grams per c c, suggested that the associated helium might be present in sufficient quantity for spectroscopic detection This has proved to be the case Thus 250 grams of Matopo granite yielded 3 c c of nitrogen on heating This nitrogen, on sparking down, gave a residue of about 1/100th part of its own volume The residue was introduced into a vacuum tube, and showed the spectra of argon and helium quite brilliantly, and in about equal intensity Similar results were obtained with syenite rocks from Mt Sorrel in Leicestershire, and from Norway

It seems more than probable that these observations afford an explanation of the nature of the gases evolved by mineral springs The invariable presence of a notable quantity of helium in such gases has always been considered remarkable It would seem that it may be sufficiently explained by the action of hot water in disintegrating common rocks and liberating the gases contained

It is my intention to examine a large selection of common rocks and minerals, and particularly with the view of determining whether helium in them is always associated with radium, or whether its presence can ever be attributed to radio-activity of ordinary materials

R J STRUTT

Sunnyside, Cambridge, January 13

Ionisation and Absorption and Anomalous Dispersion

DR STARK (NATURE, vol lxxiii, pp 78, 389, 533) has given a theory, based on his canal-ray experiments, according to which spectrum series are due to positive ions It occurred to me that its applicability to thermal emission might be tested by experiments on the ionisation accompanying the anomalous dispersion in sodium vapour Accordingly, together with Mr Needham, I made some preliminary experiments, using a slight modification of Prof Wood's well-known apparatus ("Physical Optics," p 340), of which the results seem to be of sufficient interest to deserve publication

We used a steel tube, 40 cm long, with an insulated iron wire stretched inside and along it about 1 cm from the sodium surface The poles of a battery were connected to the wire and tube through a liquid resistance and galvanometer (1 division $= 10^{-8}$ ampere about), the tube was placed between the collimator and grating of a spectroscope, and the image of a horizontal fine wire stretched across the slit was observed in the first spectrum with a micrometer eye-piece The separation, due to anomalous dispersion, of the two halves of the image on opposite sides of the absorption band was assumed to be a sufficient measure of the anomalous dispersion.

Curves constructed from observations of anomalous dispersion and current show that every variation of the ionisation, due to some irregularity of pressure and temperature, is accompanied by a corresponding variation in the anomalous dispersion

The simplest explanation of the parallelism between the curves is that the D lines of sodium are due to positive ions rather than to neutral atoms, in accordance with Stark's theory

G A SCHOTT

Physical Laboratory, University College of Wales, Aberystwyth, December 20, 1906.

THE MILLAIS BRITISH MAMMALS [1]

WITH the appearance of this volume we have the pleasure of congratulating the author on the completion of a very heavy task As we have had occasion to remark in our notices of the two earlier volumes, from the point of view of pictorial illustration the work is in the main all that can be desired, and there is little doubt that in this respect it will long remain absolutely without a rival Our very heartiest congratulations may accordingly be tendered to Mr Millais and his fellow artists on the result of their endeavours to illustrate in an adequate and exhaustive manner the living and recently exterminated mammals of the British Isles In giving as the

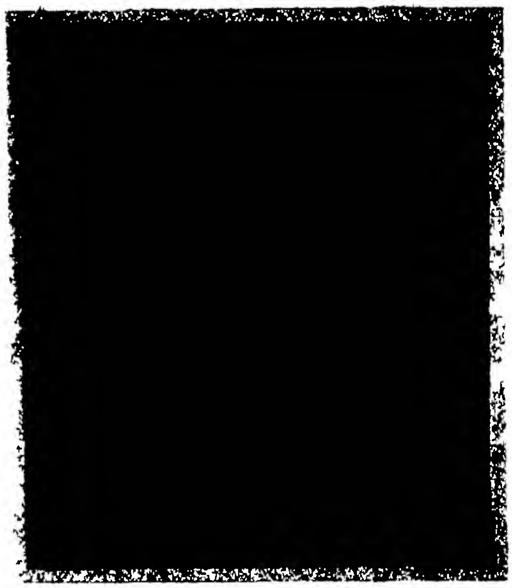


FIG 1—The Hare. From The Mammals of Great Britain and Ireland

frontispiece of the present volume a picture of a southern right-whale attacked by a party of grampuses, or killers, it may possibly be objected that the author has introduced a scene which cannot now be witnessed in British waters Since, however, the past as well as the present state of the fauna of our islands enters into the purview of the work, there may be justification for such an illustration, and even if this be not the case, the privileges of artistic license may be pleaded as sufficient excuse Had space been available, we should have had much pleasure in reproducing one of the full-page illustrations which form by far the most striking feature of the work Failing this, we have to be content in presenting to our readers (by the courtesy of the publishers) three of the smaller illustrations as examples of the pictorial merit of the work

The groups included in the present volume comprise the hares and rabbit, the ungulates, of which (if we exclude the white park-cattle, which are obviously not wild animals) the red deer, the fallow deer, and

[1] "The Mammals of Great Britain and Ireland By J G Millais. Vol III. Pp. xii+384, illustrated (London Longmans, Green and Co., 1906) Price 6l 6s net

the roebuck are the only survivors in a wild, or half-wild, condition, and the cetaceans

In regard to the hare, the author discusses, without coming to any very definite conclusion, the popular idea that this animal sleeps with its eyes open Without having any first-hand information to offer on the question, we venture to suggest that the idea has no foundation in fact, as it must be obvious that when an animal is unconscious it can make no use of its eyes, whether open or shut Many persons, it appears, doubt whether the rabbit can swim; but on this point Mr Millais has ample testimony, and he describes in detail the manner in which this rodent makes its way in the water on the rare occasions that it takes to that element

In "British Deer and their Horns" Mr Millais has already shown that he is well acquainted with the habits of the three surviving British representatives of the Cervidæ, and on this subject his observations in the volume before us are well worthy the best attention of the reader Of special interest is the statement that the new antlers of deer begin to grow before the old ones are shed, this, so far as we are aware, not having been previously recorded

FIG 2—Head of an English Red Deer killed in 1905 Points, 15 Generally considered to be the finest example taken within recent years From 'The Mammals of Great Britain and Ireland

In the course of his account of the red deer Mr Millais devotes a considerable amount of space to the contention that the division of this widely distributed species into local races is not supported by the evidence available "All the needless names on the part of scientific zoologists, who in most instances have worked on insufficient evidence, have," he writes, "only resulted in endless chaos, to the somewhat supercilious amusement of sportsmen, who in this case have shown that they know more about the red deer than the zoologists"

To the allegations in this statement we have no hesitation in giving a flat denial, and it is nothing short of presumption on the part of an amateur naturalist like Mr Millais to set up his opinion against those of specialists of the calibre of Prof Einar Lönnberg, of Upsala, and Dr. Satunin, of Tiflis

The plain fact of the matter (and there are occasions when it is necessary to write strongly) is that our author does not realise what naturalists mean by local races or subspecies, as may be gathered from his remarks concerning the intergradation of different local forms of red deer Is he aware, we may remark, that the essential idea of a subspecies is that it should intergrade with the typical or some other form of the species, and that many naturalists claim that when such connecting links have died out the aberrant form must rank as a species? Lack of knowledge characterises also his remarks concerning minor local differences in animals The fact that Perthshire grouse are distinguishable by an expert from the birds found in Caithness, and Tay salmon from Tweed salmon, is, for instance, no argument against the validity of subspecies On the contrary, it tends exactly the other way, merely giving rise to the question as to the degree in which it is advisable, or practicable, to recognise such local differences in zoological nomenclature

That the large, black-bellied eastern red deer or maral, and the small North African red deer are perfectly distinct from the typical red deer of Sweden does not admit of argument Dr Lonnberg, in a paper (*Arkiv Zool*, vol iii, No 9, 1906) which may have appeared too late for mention by Mr Millais, goes further than this, and separates the Norwegian red deer as *Cervus elaphus atlanticus* and the Scotch animal as *C e scoticus*, but these local forms, as might be expected, are much nearer one another than are those mentioned above

In treating of the white park-cattle, Mr Millais, we are glad to see, recognises the fact that they are essentially descendants of albino domesticated breeds, and in no sense wild animals He believes, however, that they are derived from Continental rather than British breeds In this respect he runs counter to the opinion of Low, who knew more about these cattle than many later writers, and it would seem that he is unacquainted with the white Pembroke breed, of which specimens are now living in the Duke of Bedford's park at Woburn Anyone who has seen these animals will have little doubt as to where to look for the ancestry of all breeds of park-cattle

In regard to relics of the old wild ox or aurochs Mr Millais states, on the alleged authority of the present writer, that two horns, formerly used as drinking cups, are preserved in Paris If he will refer to "Mostly Mammals" he will find it stated that, up to the French Revolution, both these horns were preserved in Alsace, and that only one, which probably did not belong to the aurochs at all, was mounted as a drinking cup Both have now disappeared so far as can be ascertained Since Mr Millais is sceptical as to the view now generally accepted with regard to the colour of the aurochs, or urus, it may be well to quote the observations on

this subject of Prof T. Noack, who, after referring to certain errors by the copyist in the German edition of Herberstain's work published in 1556 or 1557,[1] concludes as follows:—"Der *Bos primigenius* hat sich aber zweifellos in verschiedene Lokalrassen gespalten, die vielleicht auch verschieden gefärbt waren, den wir haben keinen Beweis dass alle Ure schwarz mit weissgrauem Rückenstreif waren, der auch bei dem Herberstainchen Exemplar sehr gut angedeutet ist" As the late Prof Nehring was also convinced that Herberstain's aurochs was black, it will require much more evidence than is offered in the present volume to make us believe that it was more probably red

As regards the section on British Cetacea, which occupies a large portion of the volume, we are glad to be able to accord almost unstinted praise to the author Mr Millais has seen for himself a considerable number of the species he discusses in their native waters, and he is therefore able to write with authority regarding their habits and appearance Many of his sketches and photographs are therefore of special value and interest He has, of course, much to say with regard to the recent occurrence of a number of sperm-whales in northern British waters, and as the result of these observations it may be hoped that the statement as to this species being an exclusively tropical and subtropical cetacean will in time disappear from text-books It may be added that our author appears to be in some degree of uncertainty whether the right-whales, on the one hand, and the finners and humpbacks on the other, represent families or subfamilies, since in one passage he refers to the two groups as being of subfamily rank, and yet gives their titles as Balænidæ and Balænopteridæ In referring to the horny "bonnet" and tubercles on the head of the southern right-whale, the author makes no reference to the important observations of Prof E Lonnberg in his account of the cetaceans of South Georgia, this, however, may be due to the latter having been published too late for mention

FIG 3—The Common Rorqual From "The Mammals of Great Britain and Ireland"

That the present volume and its fellows will do something to arouse greater interest among the wealthy classes (for it is not a poor man's book) in the mammals of the British Isles may be sincerely hoped In all that relates to the habits of the animals he describes, and likewise in matters connected with sport, the author, who is an energetic and enthusiastic field-naturalist may be taken, at all events in the main, as a trustworthy guide On the other hand from what has been stated above, it is evident that in matters connected with systematic zoology it will be advisable for his readers to consult the writings of trained zoologists before taking all Mr Millais has to say as gospel R L

[1] In one place Noack gives the date as 1556 and in a second as 1557

THE MATHEMATICAL TRIPOS AT CAMBRIDGE

NOT only have physicists and engineers and other men who apply mathematics been anxious for many years for reform at Cambridge, but everybody who has wished to see the study of mathematics retain its place in general education Again, nearly all who are interested in the training of those mathematicians who are expected to devote their lives to original investigation have expressed much the same anxiety The long-considered principles of a proposed large reform were brought before the Senate eight months ago in a report of the mathematics board, to which were appended twelve resolutions supported by every one of the mathematical professors and university lecturers in mathematics, and these resolutions, after they had been before the Senate five or six months, were voted upon and carried by majorities varying from 10 per cent to 40 per cent on October 25, 1906

To carry out these resolutions, regulations for the examination have been prepared, and must be approved at an early meeting, but at this late hour a force is being organised which means, not merely to oppose the regulations, but to kill all hopes of reform by reversing the recent decision of the Senate

The proposed syllabus of subjects for part I includes geometry, algebra and trigonometry, and analytical geometry with elementary work in the infinitesimal calculus, dynamics, and optics It seems to us very good, and will no doubt in time in the hands of the mathematics board become excellent Six papers will be set, each paper possibly containing questions from all parts of the syllabus The questions in the physical subjects will be of such a character as to test knowledge of the physical phenomena and their relations, and not merely an ability to deal with the analytical developments of hypotheses A large proportion of such riders as are set will consist of simple examples illustrating numerically or otherwise the corresponding theory In their answers candidates will not be restricted to the use of the methods indicated in the syllabus The most important regulations are that a student may take part I in his second term, and that the three lists of honour men shall be placed in alphabetical order

Schedule A of part II is not only an excellent course on mathematics, including elementary parts of the theory of functions and differential equations but it includes those parts of dynamics hydromechanics, astronomy, electricity and optics (we wish we could say physical optics) which give the best illustrations of the applications of the mathematical part, illustrations which must be interesting even to

those students who are likely to proceed to the highest work in pure mathematics. Schedule B comprehends the highest kind of work in all parts of pure and applied mathematics which may be expected from men of the age and experience of the best candidates.

The examination in part ii comprises the subjects in Schedules A and B. Schedule A contains the ordinary subjects to be taken by all candidates, the B subjects being taken only by men who are candidates for a mark of distinction. Six papers will be set on A and not more than six papers on B. In each of the papers on A there will be set some simple questions specially indicated, partly on the syllabus of part i., a candidate who answers these questions sufficiently well will be entitled to honours. The questions on the various subjects will be distributed among the papers at the discretion of the examiners. Some months before the examination the registrary must be furnished with names of students who intend to present themselves as candidates *for distinction* in subjects B, specifying their special subjects or branches of subjects, and still some time before the examination students will specify the range of subjects B in which they desire to be examined. It is again laid down, as in part i., that there will be tests of knowledge of phenomena in the physical questions, and simple numerical or other illustrations will be given. Also the questions on even the subjects of Schedule B will consist in part of questions of an elementary or simple character. Part ii cannot be taken earlier than in the eighth term. The list of successful candidates for honours will be in three classes, wranglers, senior optimes, and junior optimes; the names in each being in alphabetical order. The class in which a man is placed depends usually on his answers in Schedule A, but in case of doubt his answers to B may be consulted. A distinctive mark is attached to the name of a man who has done fairly well in Schedule B, and a different mark if he deserves special credit for his answers to B.

Now there is no doubt that much depends upon the spirit in which an examiner acts, he may greatly help or hurt the desires of the reformers, but surely this reform is a great step in the right direction. The old order of merit did incalculable harm. Candidates spent far too much time in the details of the general mathematical course, and as straightforward questions would have been answered equally well by all the good men, to differentiate them it was necessary to set questions which were complex and indeed tricky. Again, a just order of merit can be arranged only if all students are examined in the same subjects, and to compel all students to study the same subjects in the one way that leads to success in such an examination is uneducational. Not only has the course of study been mischievous for physicists and engineers, who ought to be allowed to advance quickly to those parts of higher mathematics which are necessary for them, but it is utterly uninteresting and hateful to the general student, for whose culture it might be made valuable. The greatest sufferer hitherto, however, has been the real mathematician, who is drilled so long on elementary work that even after he becomes a wrangler he is only ready to begin that higher work which he might have studied years before. In nineteen cases out of twenty he has become stale, so that even when he becomes a teacher of mathematics he is no longer a student. It would be useless for us to express an opinion as to the effect of the examination upon those Cambridge pure mathematicians from whom an advancement of knowledge might be expected; a senior wrangler of European reputation has given a curious opinion in NATURE, February 12, 1903, p. 339.

This reform will be far-reaching; it will extend to all places in Great Britain where a Cambridge man teaches, and to all examinations in which the Cambridge examiner has been in the habit of setting riddles and conundrums as questions. A large general committee has been formed of men who think that the regulations should be approved. It is representative of Cambridge at its best, not merely in men who teach, but in men who are doing original work in pure mathematics and mathematical physics and engineering, as well as in history and literature, scholars and workers of all kinds. It would be invidious to compare with these the names of the men who have organised the opposition. A scrutiny of the October votes shows that the members of Senate who are resident in Cambridge are in favour of reform by majorities considerably more than in the case of the general members. The opponents of reform now call upon all country members to come to Cambridge and record their votes. Should they persist in their intention, it is just possible that they may succeed in reversing the recent decision of the Senate, but if they do they are establishing a precedent which cannot conduce to the smooth and consistent working of the University.

There is another matter for these gentlemen to consider. Should they succeed, it is certain that the reformers will ask for and obtain a Parliamentary Commission. Is it likely that such a commission will inquire only into the question of mathematics? There is the Greek question, and there are others which the opponents of reform surely do not wish to have examined. Some of us wish that they would persevere and defeat the reformers, so that our greatest university might through a commission get those other reforms which it is hopeless to expect from the Senate.

JOHN PERRY.

THE INTERNATIONAL SEISMOLOGICAL ASSOCIATION

THE first meeting, since its definite organisation, of the committee of the International Seismological Association was held at Rome on October 16, 1906, and was attended by representatives of each of the States belonging to the association. The United States having quite recently joined, the only important outstanding countries at present are Great Britain and France. The answer of France has not yet been received, while Great Britain has signified its intention to join under certain conditions, among which the simultaneous adhesion of France is the only one which at present prevents our country from being a member of the association. Nevertheless, both countries sent representatives to the meeting, M. Bigourdan acting for France and Prof. Schuster for Great Britain.

The time of the meeting was taken up in great part by questions of organisation, as, for instance, the drawing up of regulations concerning the procedure of the committee itself. Prof. Palazzo, of Rome, occupied the chair, and was re-elected president until the general meeting of the association, which is to take place in September. Reports were presented from the various States showing the organisation of the seismic service in the different countries, and these reports gave evidence of the great interest now generally taken in the seismic tremors of the earth.

The more important scientific questions submitted to the conference were deferred for decision to the general meeting in the present year, but it was decided to supply the Arctic station of Disko with an instrument for measuring the vertical component of disturbances, and to open a competition for the

construction of a seismograph which shall be suitable for the measurements of tremors having their source near the place of observation. Advertisements giving details of this competition have appeared in various papers in this country (see NATURE, January 3, p. xci).

It may be remembered that an organisation for studying the propagation of earthquakes was discussed at the last meeting of the International Association of Academies held in London in 1905, and that a committee was then appointed to formulate the views of the united academies, the originally proposed scheme for the seismic organisation not having met with general approval. This committee met, and its recommendations were subsequently approved by the council of the International Association of Academies. The International Seismological Association has accepted the suggested modifications, the general tenor of which was to safeguard the internal organisation of the earthquake observations in different countries, confining the international work to those physical questions of earthquake propagation which can obviously only be dealt with on an international basis. It is to be hoped that the spirit of these modifications will be adhered to, and that no attempt will be made to encroach on the functions which more definitely concern each country separately. We are glad to note, therefore, from the proceedings of the recent conference that both the questions of a more particular study of the districts surrounding Vesuvius, which primarily concerns Italy, and the foundation of a station in Iceland, which primarily concerns Denmark, were postponed.

The social functions of the international meeting were well looked after at Rome, the members being most hospitably entertained, and also provided with tickets enabling them to travel at about half-fare over all State railways during the meeting, and for several days before and after.

SCIENCE IN HIGHER EDUCATION

IT is satisfactory to notice the attention now being given to scientific methods in education, not only by teachers and others actively engaged in educational work, but also by prominent statesmen. During the past week several important educational conferences have been held, and a report of one specially organised by science teachers appears elsewhere in this issue. But the dominating note of other conferences concerned with the school curriculum in general and subjects belonging to the literary side of education in particular is that of scientific method. Whether in the study of ancient or modern languages, in the cultivation of mental attitudes or the development of the body, it is clear that authoritative opinion considers the best methods of teaching should be based upon principles which have long been advocated by men of science. The little leaven of science is leavening the whole lump of educational effort, and the result is gratifying to contemplate.

Provided that scientific methods are adopted, that is, methods which aim at making pupils work out their own intellectual salvation, it does not matter much what subjects are studied. What we have always wished to avoid, and what we are glad to see now meets with unanimous disapproval, is instruction which is not education, the drudgery of learning phrases or performing mental gymnastics in literature, mathematics, or science without attention to the more valuable faculties of critical thought and originality. From the condition of a passive absorber of teachers' notes and the pemmican of text-books of former days, the pupil is gradually being recognised as an active agent who may be led to make his own observations and form his own conclusions, whatever the subject of study may be. It can scarcely be said at present that the old methods have disappeared from our schools and colleges—the requirements of the old universities and examining bodies prevent this end from being reached—but the feeling of practically all active thinkers and workers in the world of education is in favour of the adoption of principles with which we are completely in sympathy, and their influence is gradually giving the spirit of life to what have been the dead bones of school work.

Our statesmen, also, and in particular Mr. Haldane, Secretary of State for War and president of the British Science Guild, are taking opportunities to impress upon the nation the essential part which science and higher education must play in the polity of the modern State if progress is to be secured. We are glad, therefore, to extract from reports of speeches made last week by Mr. Haldane and Mr. Asquith some remarks expressing conviction of the value of factors which have long been recognised in these columns as essential to national welfare.

SCIENTIFIC THOUGHT

An international economic congress, arranged by the council of the Royal Economic Society, was held on January 9 and 10 at the London School of Economics. Mr. Haldane, M.P., occupied the chair during the earlier portion of the morning session on the first day as president of the society, and delivered the introductory address. Mr. Haldane is reported by the *Times* to have said:—What ever other differences there may be between the nations there is a brotherhood—a brotherhood the reality of which is asserting itself more as year succeeds year—the brotherhood of science. We are to-day recognising that in science, as well as in other things, international cooperation is essential, and perhaps in no department is that more marked than in the department which deals with the science of the State. It is not only in economics that this kind of wider outlook is beginning to come to people. In science of every kind we have witnessed the tendency of the nations to specialise. Perhaps it is more easy to preserve a common basis in those sciences which do not touch human nature, but there is one thing that is true of all sciences, and that is that their methods are necessarily abstract. Do not let us be carried away with the notion that because a method is abstract therefore it is not an indispensable method for getting at the truth. It is obvious that the chances of reaching the truth are greater in certain cases the greater the abstractness of the method.

I have at this moment two books in my mind books which in a sense are to-day out of date but which, in another sense, will never be out of date, because they are the most perfect illustrations of true scientific method—the method which does not allow itself to shut out of view facts by the narrowness of its conceptions. One is Darwin's "Origin of Species," the other is Adam Smith's "Wealth of Nations," a book written by a man who had profoundly freed his mind from every kind of narrowness.

After dealing with the value to statesmen of the study of economics Mr. Haldane spoke of the internationalism of science. He remarked:—It seems to me that this tendency to the internationalism of science, which is again after 300 or 400 years beginning to set in, which does not depend on our speaking a common language but does depend on our becoming more and more specialists working out different departments of great and complicated questions—it seems to me that this new tendency is one which should fill us with hopefulness for the future. It has been said, and said with truth, that this is not an age of great men. We do not seem to be producing a Newton or a Gauss, a Helmholtz or a Laplace with the frequency with which former generations produced these outstanding figures, and yet, on the other hand, who will doubt that the general level of science is far higher to-day than it was a generation ago, and still higher than it was a generation before that? People have realised that it is

because of the necessity of specialisation, just because of the vast amount of work which people will have to do if they are to do anything successfully, that the men of science to-day have to know a great deal more, and therefore have to specialise a great deal more, before they can work usefully for the realisation of a common purpose It is an age in which we recognise the enormous strides which science has made, the vast amount that has to be known before an individual contribution is possible It is an age in which we are coming to see more and more clearly that the man who will contribute anything, who wishes to serve his country, who wishes to serve the world, does best to confine himself to that which he is sufficiently furnished to undertake "He" wrote a great man, "who would accomplish anything in this world must learn to limit himself" and that is essentially true of science to-day

The University Spirit and Function

Mr Haldane delivered his address as Lord Rector of the University of Edinburgh on January 10 He referred at length to the function of the university in the modern State The first purpose of a nation—and especially of a modern nation—ought, he said, to be to concentrate its energies on its moral and intellectual development, and this means that because it requires leaders as the instruments of this development, it must apply itself to providing schools where leaders can be adequately trained At this point the history of the modern State shows that the university plays an important part For the production of that small body of men and women whose calling requires high talent, the university alone, or its equivalent, suffices It is the almost indispensable portal to the career of the highest and most exceptionally trained type of citizen If universities exist in sufficient numbers and strive genuinely to foster the moral and intellectual virtue the humanity which has the ethical significance that ought to be inseparable from high culture, then the State need not despair For from among men who have attained to this level there will emerge those who have that power of command which was born of penetrating insight In a university it is not merely the lecture rooms and laboratories and libraries that are important—the places where those who are busy in the pursuit of different kinds of learning meet and observe each other are hardly less so The union the debating society, the friendship of those who are struggling to maintain a high level—all these things go to the making of the scholar Certainly in the Scottish university of to-day there is no lack of either opportunity or provision for the formation of the tastes of the scholar and the habits of the worker A man may go from these surroundings to devote his life yet more completely to literature, or science, or philosophy, or he may go to seek distinction in a profession or success in commerce Whatever occupation the student chooses, he is the better the greater has been his contact with the true spirit of the university The university training cannot by itself supply capacity, but it can stimulate and fashion talent and above all, it can redeem from the danger of constricted views Thus the university becomes a potent instrument for good to a community, the strength of which is measured by the capacity of the individuals who compose it The university is the handmaid of the State of which it is the microcosm—a community in which also there are rulers and ruled, and in which the corporate life is a moulding influence

Speaking of the true and two fold function of the university Mr Haldane said it is a place of research where the new and necessary knowledge is to be developed It is the place of training where the exponents of that knowledge—the men who are to seek authority based on it—are to be nurtured and receive their spiritual baptism Such a university cannot live or thrive under the domination either of the Government or the Church Freedom and development are the breath of its nostrils, and it can or recognise no authority except that which rests on the be ... of the Truth to command obedience It was Lessing effect o... lared that were God to offer him the Truth in one mathema... the Search for Truth in the other, he would ledge ... Search and it is in the devotion to this search European re... high—a search which may assume an infinity of varied forms—that the dedicated life consists, the life dedicated to the noblest of quests, and not to be judged by apparent failure to reach some fixed and rigid goal, but rather by the quality of its striving.

Mr Asquith, Chancellor of the Exchequer, delivered his address as Rector of Glasgow University on January 11. He took as his subject "Ancient Universities and the Modern World" He said the mediæval universities had two characteristics, they were always in theory and almost always in practice cosmopolitan, and the true university has always been, in addition, catholic in its range A university never was, is not, and never ought to become a technological institute for the creation and equipment of specialists The limits of the knowable, wherever they are to be placed, have in these days expanded so far that no ambition and no assiduity is equal to the task of taking all that lies within them for its province Nothing can be more alien, then, from the business of a university than to produce the shallow and fluent omniscience which has scratched the surface of many subjects and got to the heart of none The fidelity of a university to the intellectual side of its mission must now, as always, be judged by the degree in which it has succeeded in enlarging and humanising the mental outlook of its students and developing the love of knowledge for its own sake Such an ideal does not imply a divorce of knowledge from practice When James Watt in 1756 came back to Glasgow from London the Corporation of Hammermen refused him permission to set up his business in the burgh because he was neither son of a burgess nor an apprentice The Faculty of Professors of whom Adam Smith was one, at once appointed him mathematical instrument maker to the University and gave him a room in the college buildings for his workshop It is often out of the mouths of professors and at the hands of universities that the practical man learns for the first time the real meaning and the latent possibilities of his own business In the long run a university will be judged, not merely or mainly by its success in equipping its pupils to outstrip their competitors in the crafts and professions It will be judged also by the influence which it is exerting upon the imagination and the character, by the ideals which it has implanted and nourished, by the new resources of faith, tenacity aspiration with which it has recruited and reinforced the untrained and undeveloped nature, by the degree in which it has helped to raise to enlarge to enrich, to complete the true life of the man and by and through him the corporate life of the community

Universities and the Schools

Presiding at a meeting of the Scottish Education Reform Association, held in Glasgow University on January 12, Mr Haldane spoke of the necessity for reform in Scottish university arrangements If teachers are to be trained there must be considerable elasticity, access to the university must be easy and yet difficult A man should not go there who is not fit to take a university training, and if he is not fit to take that he is not fit to be a Scottish teacher On the other hand, access to the university should not be a straight and narrow gate, accessible only to people who approach by one particular path If a high standard is to be secured in fashioning that elasticity, greater individual freedom must be given to each of the Scottish universities The Act of 1889 was passed in the days when what was called the federal idea was dominant If the Scottish universities were freed so that they might pass ordinances which would open their territories still wider and give a larger range in subject and vision, a greater elasticity in fashioning their degrees, it is certain that there would be no lowering of the standard, there would be a heightening In education, primary, secondary, and higher schools cannot be separated one from the other, they must be treated as one, and the teachers matter more to the schools than anything else Mr Haldane protested against the superstition that it is possible to form a judgment upon things that require a great deal of knowledge without possessing that knowledge The leadership in education in Scotland must be in competent hands, and the key to the situation is the raising of the *status* of the teachers in Scotland, and that is to be done by binding them more and more closely with the universities.

CORNELIUS O'SULLIVAN, F.R.S.

THE death of Mr. Cornelius O'Sullivan, F.R.S., which took place on January 8, at the age of sixty-five, has removed from amongst us a worker of great originality who, during the past thirty-five years, made his mark in various branches of pure and applied chemistry connected more or less directly with the industrial processes of brewing.

A native of Bandon, co. Cork, O'Sullivan developed a taste for science at a very early age, and having obtained a scholarship at the Royal School of Mines went through the three years' course with distinction, and became attached to the teaching staff of the Royal College of Chemistry, then in its old quarters in Oxford Street. In 1866 he became private assistant to Prof. A. W. von Hofmann, whom he accompanied to Berlin in that year. In the following year he entered the business of Messrs. Bass and Co. at Burton-on-Trent, where he ultimately became the head of the brewing and scientific staff, a post which he occupied up to the time of his death.

When O'Sullivan entered the brewing business the new ideas and discoveries of Pasteur with regard to fermentation were beginning to exercise a marked influence on brewing practice, and there seemed some danger of the new science of bacteriology occupying the field to the exclusion of chemistry. It is the special merit of O'Sullivan that, although very receptive of these new ideas, he clearly recognised that all the biological problems with which the brewer has to deal must ultimately be referred to the chemist, and he therefore set to work, in the first instance to investigate the nature of starch and the mode in which it is transformed under the hydrolytic agencies of diastase and acids. In these researches O'Sullivan made use of the polarimeter, and by a combination of the optical method with that of cupric reduction he elaborated processes for a study of the gradual disintegration of the starch molecule which have been employed by all subsequent workers. In following the course of the action of diastase on starch, he conclusively proved that the sugar which is formed is not, as was then generally believed, glucose, but a well-defined crystallisable biose, maltose, and that the dextrins which are simultaneously formed consist of several bodies differing amongst themselves by certain well-marked properties. His researches on the influence of temperature on the reaction led to certain valuable practical applications, with which every student of brewing technology is now familiar. The results of O'Sullivan's work on starch were published in the Journal of the Chemical Society between 1872 and 1879, and constitute a series of memoirs which are justly regarded as classical.

O'Sullivan then turned his attention to the amylans and other carbohydrates of the cereals, and also extended his researches to the gums of the arabin series and to gum tragacanth. Throughout the middle and later period of his life he studied the action of the enzyme invertase on cane-sugar, and in a remarkable memoir published on this subject, in collaboration with Tompson, there is a vast amount of information which seems destined some day to assist in finding a rational explanation of the mechanics of enzyme action.

In 1884 the Chemical Society marked its appreciation of O'Sullivan's work by awarding him the Longstaff medal, and in the following year he was elected a Fellow of the Royal Society.

The varied life-work of O'Sullivan affords an excellent example of the brilliant results which can be attained by the close union of pure science and technology, and of the constant reaction of one on the other. Of all our industries there is not one, with the possible exception of agriculture, which is able to suggest so many problems in chemistry, physics and biology as the ancient industry of brewing, and no one understood this better than the subject of this brief notice. Of his fine personal qualities and of the influence he had on the younger workers in a field which he made specially his own this is not the place to speak; suffice it to say that his generous, warm-hearted Celtic nature endeared him to a large circle of friends who are now mourning his loss.

NOTES

THE council of the Royal Astronomical Society has awarded the gold medal of the society to Prof. E. W. Brown, F.R.S., professor of applied mathematics at Haverford College, Pennsylvania, U.S.A., for his researches in the lunar theory.

THE Göttingen Königliche Gesellschaft der Wissenschaften has elected the following foreign members:—Prof. H. A. Lorentz, Leyden; Prof. L. Luciani, Rome; Lord Rayleigh, Pres.R.S.; and Prof. C. S. Sherrington, F.R.S.

THE council of the Royal Geographical Society has elected Mr. Roosevelt, President of the United States, an honorary member of the society. President Roosevelt has intimated his acceptance of this distinction.

PROF. E. L. NICHOLS, professor of physics in Cornell University, has been elected president of the American Association for the Advancement of Science for the meeting to be held next year at Chicago.

M. BOUQUET, director of technical instruction to the French Minister of Commerce, has been elected director of the Conservatoire national des Arts et Métiers for a period of eight years from January 1 last, in succession to M. Chandèze, who has retired.

WE learn from the *British Medical Journal* that the French Government has asked the Pasteur Institute to undertake an inquiry as to the distribution of malaria in various centres of colonisation in Tunis, especially the Béja, Mateur, and Goubellat regions, and as to the means of checking the prevalence of the disease.

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal to Prof. W. J. Sollas, F.R.S.; Murchison medal to Mr. Alfred Harker, F.R.S.; Lyell medal to Dr. J. F. Whiteaves, of Ottawa; Wollaston fund to Dr. Arthur Vaughan; Murchison fund to Dr. Felix Oswald; Lyell fund to Mr. T. C. Cantrill and Mr. Thomas Sheppard; the Bigsby medal to Mr. A. W. Rogers, of the South African Museum, Cape Town.

NEW YORK UNIVERSITY has received a gift of about fifteen acres of land adjoining the south line of its grounds. The value of the property is, *Science* states, said to be between 40,000*l.* and 60,000*l.* From the same source we learn that Mr. Andrew Carnegie has given to the College of Physicians of Philadelphia 20,000*l.* toward the erection of its new building, on condition that a like sum be subscribed, of which 16,000*l.* has already been received.

WE announce with regret the death of the Very Rev. Robert H. Story, principal of Glasgow University, on January 13. For twenty-seven years Dr. Story was minister of the parish of Roseneath, and in 1886 he was appointed to the professorship of ecclesiastical history in the University of Glasgow. In 1898 he succeeded the Rev. Dr.

Caird as principal of the University He was mainly instrumental in raising a special fund of nearly 100,000*l* for improving Glasgow University

A REUTER message from Samarkand reports that the eclipse of the sun on January 14 was observed from a point at the 1481 verst on the railway between the stations of Kuropatkino and Mijulnskaja The first sign of the eclipse was noticed shortly after 9 a m, and at 9 53 the period of total eclipse set in, lasting for two minutes Throughout the time of observation snow was falling

IN celebration of the twenty-first year of work, the president and council of the Biological Society of Liverpool have invited members of the society and their friends, along with some distinguished biologists from other towns, to a conversazione to be held on Friday, January 25 in the museum and laboratories of zoology in the University of Liverpool The hon sec of the society is Mr J A Clubb, Free Public Museums, Liverpool

THE *Daily Chronicle* announces that a "zoo" for Yorkshire on an extensive scale has been definitely settled upon A twenty-seven acres site near Roundhay Park, Leeds, has been selected Herr Hagenbach, of Germany, is acting for the promoters of the scheme An ostrich farm is to form a leading feature A correspondent at Leeds informs us that the City Council, to whom Roundhay Park belongs, is not concerned with this project, which is a private venture for purposes of profit

A SET of Watson magnetographs has been installed in the new magnetic house at Helwan Observatory, near Cairo Egypt The equipment comprises recorders for declination, horizontal intensity, and vertical intensity The temperature coefficients of the intensity instruments are now being determined, and it is hoped that this work will be completed in February, and regular observations commenced

THE rules of the aeroplane race, which is to take place on July 14, 1908, are published in the Paris *Matin* of January 14 All the machines which start, without distinction of name or of form, but of French make, will be admitted as competitors Whatever may be the meteorological conditions on the date arranged, they will have to travel from the offices of the *Matin* in Paris to the office of the same journal in London within a maximum period of twenty-four hours, using only their own means of propulsion The winner of the race will receive a prize of 250 000 francs (10,000*l*.)

EARTHQUAKE shocks were felt in the following places on January 10 —*Christiania* —Two rather severe shocks of earthquake were felt at 1 30 a m they were accompanied by rumbling sounds The shocks were felt in towns on both sides of the Christiania Fjord *Frederikstad* —A slight shock was felt at 12 15 a m, a more severe one at 1 30 a m *Gothenburg* —Two severe shocks were felt in the district between Kornsjo and Mellerud at 1 30 a m A strong shock was also felt at Strömstad at the same time *Arvika* (*Wermland*) —A violent shock occurred at 2 25 a m *Upsala* —At 1 33 a m the Upsala seismograph recorded a slight shock which lasted twenty seconds A despatch from Honolulu on January 10 states that the Mauna Loa volcano, Hawaii, is in active eruption

A REUTER message from Kingston, Jamaica, announces that on January 14 the sixth agricultural conference, under the auspices of the Imperial Department of Agriculture, was opened there by Sir J. A Swettenham, the Governor Sir Daniel Morris delivered the presidential address, which reviewed the work accomplished by the department in developing tropical industries The attendance at the opening meeting was large, those present including men of science and agriculturists from all parts of the West Indies

A VIOLENT earthquake occurred at Kingston, Jamaica, at 3 30 on Monday afternoon, January 14, and caused great loss of life and property No details of the disaster are known at the time of going to press, but it is reported that many houses and other buildings have been destroyed by the earthquake and the fires which started immediately after the shock A Reuter message from New York states that cable communication with the Bermudas was broken on Monday night The Commercial Cable Company's lines to the West Indies are also interrupted The Hamburg-American Line Agency has received a message from Holland Bay, January 15 (5 38 p m), stating that a slight earthquake occurred there on Monday, but no damage was done The seismograph at the offices of the U.S Weather Bureau, Washington, recorded vibrations beginning at 3h 38m 23s, on Monday afternoon Mr Metcalf, Secretary for the U S Navy, has cabled to Rear-Admiral Evans, commanding the U S Fleet off Guantanamo, Cuba, directing him to investigate the extent of the Jamaica disaster and report to the Navy Department A *Daily Mail* correspondent at Christiania reports that an earthquake was felt on Monday afternoon at Trondhjem and over the greater part of northern Norway At some places the shock was severe enough to shake the houses

MR HALDANE, Secretary of State for War, has approved of the amalgamation of the Army Medical Advisory Board and the Army Hospital and Sanitary Committee The reconstituted Army Medical Service Advisory Board is composed of the following members —chairman, the Director-General, Army Medical Service, vice-chairman, the deputy Director-General, Army Medical Service Members Lieut -Colonel D Bruce, C B, F R S (as expert in tropical diseases), Colonel G K Scott Moncrieff, C I E, Assistant Director of Fortifications and Works, Lieut-Colonel C H Melville (as expert in sanitation) Civilian members Sir F Treves Bart, G C V O, C B, Dr J Rose Bradford, F R S, professor of medicine, University College London, Dr Louis Parkes, consulting sanitary adviser to H M Office of Works, Dr M S Pembrey, lecturer in physiology, Guy's Hospital, Sir Charles A Cameron, C B, professor of chemistry and hygiene, Royal College of Surgeons, Ireland Representative of the India Office Surgeon-General A M Branfoot, C I E Secretary Lieut -Colonel C H Melville

THE British Academy has received the sum of 10,000*l* for the purpose of establishing a memorial to the late Mr Leopold Schweich, of Paris. In accordance with the wishes of the donor, the endowment is to be called "The Leopold Schweich Fund," and is to be devoted to the furtherance of research in the archæology, art, history, languages, and literature of ancient civilisation, with reference to Biblical study There are to be annually not fewer than three public lectures—"The Leopold Schweich Lectures"—to be delivered in London, and as the ordinary rule in the English language, dealing with some subject or subjects coming within the scope of these studies The residue of the income of the fund, with all sums which may hereafter be added thereto by gift, bequest, or otherwise, is to be applied for the purposes of excavation, and for the publication of the results of original research in connection with one or more of the subjects named

It is with regret that we have seen the announcement of the death of Mr T R. Dallmeyer, who was for many years the managing director of the celebrated firm of J. H. Dallmeyer. He was the son of Mr J H. Dallmeyer, and grandson of Andrew Ross, and to a worthy degree carried on the work of these pioneer opticians Mr Dallmeyer designed several lenses and other photographic apparatus, but is best known as the inventor of the telephotographic lens Although it was found not to be an absolute novelty, its introduction as a practical photographic instrument was due to him He also worked out a modified combination for small cameras, the "Adon," which about doubles the linear measurement of the image without any loss of rapidity or need for focussing In passing away at so early an age as forty-seven, the optical and photographic world loses one from whom they seemed to have good reason to hope for much further service

The metric system is to be adopted at the works of Kynoch (Ltd) Mr Arthur Chamberlain, chairman of the company, has made a statement explaining that it is intended to carry out the whole of the clerical work, relating to interior economy, in metric units The clerical work relating to customers will only be shown in metric units so far as these measures are already in use with their customers carrying on business in countries that have already adopted the metric system We learn from the *Times* that Mr Chamberlain says the change will neither be expensive nor difficult Weights expressed in British units will be translated into kilograms, and the cost into decimals of a pound sterling This will be done by simple reference to a card of equivalents Thereafter in all its processes through the works an article will remain as so many kilograms at a decimal of a pound sterling per kilo In this way the cost of every article will be traced through all its processes in metric units and decimals of an English pound, but the selling price so arrived at will be changed into English currency The total cost of the introduction of the new methods of calculation is estimated at ½ per cent of a year's profits The saving on the other hand on clerical labour will repay this in the first year It will be seen that, so far from asking the clerks to learn anything fresh they will only be invited to forget old troubles

Cardiff has given a lead to the rest of Wales by the establishment of a public observatory Eleven years ago a suggestion was made in a local journal that a public telescope would be a most desirable acquisition Following on this, Mr Franklen Evans, J P, a well-known local man of science, offered to the town his 12-inch reflector and sidereal clock, the offer being made through Mr Arthur Mee, the then president of the Astronomical Society of Wales Various difficulties stood in the way and it was not until a couple of years ago that one of the councillors—Mr J A Kidd—took the matter seriously in hand, and succeeded in rousing his colleagues to carry it through In the meantime, the donor of the instrument had passed away When, however, the council really moved, it made up for previous indifference The telescope was put in thorough repair, and a suitable house built for it on Penylan Hill, which lies to the north-east of Cardiff, and is 250 feet above sea-level In the final arrangements invaluable assistance was rendered by Mr Albert Taylor, H M I S, who resides at Cardiff, and has had great practical experience in the construction and use of telescopes. The observatory, which was formally opened by the Lord Mayor, is controlled by a committee of which Mr Kidd is chairman, and consisting of city councillors and members of the Astronomical Society of Wales The telescope is clock-driven, and an attendant has been instructed in its manipulation and use An illustrated descriptive pamphlet has been prepared by Mr Mee and large numbers of people are visiting the observatory and viewing the heavens through the telescope

Staphilinid beetles, chiefly American, form the subject of part vi of vol xvi of the Transactions of the St Louis Academy of Science The author Mr T L Casey, takes occasion to mention that throughout the work he employs the term "America" as equivalent to the United States

Longicorn beetles from Selangor and Perak, described by Mr C J Gahan, of the British Museum, and a continuation of Mr H C Robinson's synopsis of the birds of the Malay Peninsula, constitute the zoological contents of No 4 of the first volume of the Journal of the Federated Malay States Museums

In the Proceedings of the U S National Museum (No 1428, vol xxxi pp 575–612) Mr W M Lyon describes a collection of mammals from the small islands of Banka, Mendanao, and Billiton, lying between Sumatra and Borneo Although many are described as new, nearly all are closely allied to well known species and none is of special interest

Parts ii and iii of vol xxxvi of Gegenbaur's *Morphologisches Jahrbuch* are entirely devoted to the comparative anatomy of the Primates, Mr G Ruge dealing with the characteristics of the liver throughout the order while Dr H. Bluntschli discusses the femoral artery in the lower catarrhine monkeys Both papers are of a highly technical character and of interest chiefly to specialists

We have received a copy of an illustrated "Handbook to the Perthshire Natural History Museum and Brief Guide to the Animals Plants, and Rocks of the County" The Perthshire Museum, as is well known, sets an admirable example to other institutions of the same nature in devoting its attention to the local natural history and in issuing this "Guide" (at the price of 3*d*) it will afford valuable assistance to local observers and collectors

In the December (1906) issue of the *American Naturalist* Prof H F Osborn completes his elaborate survey of the causes which have been most conducive to the extinction of the larger mammals As the result of this survey it is concluded that such extinction cannot be attributed to any one general cause Indeed, the chief induction which can be drawn from the investigation is that when the numbers of a species have been seriously reduced from some chief or original cause, various other destructive causes come into action, thus producing a cumulative effect which may lead to complete extinction In fact, from weakening its hold upon life at one point an animal species becomes subject to attack at many other points

To the January number of the *Naturalist* the Rev O P Cambridge communicates a note on the power possessed by certain spiders of the family Salticidæ of changing the colour of the large pair of eyes on the forehead Some time ago Mr. W W Strickland, of Singapore, announced the occurrence of this phenomenon in two species of Attis spiders from Java, stating that he believed such a change to be unknown in any other creature Mr Cambridge points out that Mr Strickland's observations were long ago anticipated, in the case of other species by the late Mr J Blackwall The same issue contains a

photograph of a basking-shark (*Selacho maxima*), measuring just short of 24 feet in length, taken in salmon-nets at Redcar in August last

IN the *National Geographic Magazine* for December, 1906, Miss E R Scidmore graphically describes Kedda-operations in Siam, accompanying her notes with reproductions of a number of photographs of a herd of elephants being driven towards the enclosure, and of the same herd, or individual members thereof, in the coral The Siamese Royal elephant hunt, which used to be an annual institution, is stated by the writer to be the largest affair of its kind in the world, but the steady increase of cultivation and civilisation in the country threatens the survival of the wild elephant The hunt represented in the photographs was held after the King's return from Oxford and America, and resulted in the capture of 250 elephants In Siam the tame elephant has apparently a much better time than its wild relative, the former looking sleek and well groomed, while the latter is gaunt and weather-worn with projecting ribs and patches of fungoid growth on its hide

WE have received the report of the Government bacteriologist of Natal, Mr H Watkins-Pitchford, for the year 1904-5 The greater part is occupied with experiments on, and results obtained by, the Rideal-Walker method of testing disinfectants Experiments were also made on the use of sulphate of copper for purifying water, a strength of one part of the salt to 75 000 parts of water being recommended as being both valuable and safe A nodular disease of the intestines of sheep, due to a small worm, is also described

THE Bulletin of the Johns Hopkins Hospital for December, 1906 (xvii, No 189), contains a second series of interesting reports on the comparative surgery of the lower animals, together with observations on distemper in dogs, from the latter it is concluded that the ætiological agent of this disease has not yet been definitely established Dr Knopf contributes an article on "Tuberculosis a Social Disease," which contains many useful maxims for the suppression of the disease

AS the result of an examination of material assigned to *Rhus glabra* from many different parts of the United States, Mr E L Greene, in a paper published in the Proceedings of the Washington Academy of Sciences, vol viii, separates from the species twenty-eight segregates of which five had previously been suggested as independent species While there is good reason for splitting the species the present affords a good instance in which the true value of the species would be best determined by cultivation and not merely as appears to have been the case from a study of herbarium specimens

WHEN engaged upon the inquiry into the devastations caused by bark-boring beetles among the "chilgoza" trees, Mr E P Stebbing was able to acquire an amount of information about the forests of Zhob, Beluchistan, and the Takht-i-Suliman Range in the North-West Frontier Province of India, that is embodied in the Indian Forest Bulletin No 7 The chilgoza, *Pinus Gerardiana*, highly valued for its edible seeds forms in parts extensive forests of fine trees 70 feet to 85 feet high and 9 feet to 12 feet girth, in a few localities the blue pine, *Pinus excelsa*, is associated with it in appreciable quantity Owing to indiscriminate collection of the cones, unrestricted grazing, and attacks of the boring beetles, it is shown that the forests, valuable alike for timber and their influence upon the water supply, require immediate conservation

OF the scientific papers published in the report for 1906 of the Missouri Botanical Gardens, the most important contributed by Mr. G. G Hedgcock deals with chromogenic fungi producing colour on wood A large number of fungi were carefully cultivated through various stages, and it was found that the blue, grey or brown, and black colours produced respectively by the genera Cerastomella, Graphium, and Hormodendron were contained in the fungus filaments, and no stain was exuded, but in the case of Penicillium and Fusarium the pigments were exuded and taken up by the wood cells A brief note by the same writer on zonation in fungus cultures, caused by alternations of day and night, relates to the results obtained under different monochromatic solutions On the subject of abnormal plant developments, Mr J. A Harris describes saccate structures, "ascidia," formed by the fusion of two leaves, or the edges of one leaf in Gasteria and Agave, and prolifications of capsicum and passion-flower fruits, while Mr H Hus refers to fasciation in *Oxalis crenata*

THE discovery of petroleum in the Gulf Coastal Plain of Texas and Louisiana has created a demand for specific knowledge of the geological relations of the oil The demand was for the time met by the publication in 1903 of a United States Geological Survey report The rapid development of the industry has necessitated a new examination of the fields, the results of which are given in a masterly memoir (Bulletin No 282) by Mr. N M Fenneman Detailed descriptions are given of topography, geology, and production of the Spindletop, Sour Lake, Batson, Saratoga, Matagorda, and minor oilfields and useful information on the utilisation of the petroleum and on the methods and cost of well drilling is appended

THE Geological Survey has prepared a very valuable memoir on the oil shales of the Lothians (Ordnance Survey Office, Southampton, price 4s) The memoir covers 194 pages, with three plates and sixty-four illustrations in the text, and is divided into three parts The first by Mr H M Cadell and Mr J S Grant Wilson, treats of the geology of the oil-shale fields The second part, by Mr W Caldwell, an experienced mining engineer, gives an account of the methods of working the oil shales The third part, by Mr D R Stewart, chemist to the Broxburn Oil Company, deals with the chemistry of the oil shales and the processes and products of manufacture The whole report, which has been edited by Dr Horne, forms the most complete monograph that has been written on the important oil-shale industry of Scotland The first published description of the oil shales was a short paper contributed by Mr Cadell to the British Association in 1885 More detailed accounts were contributed by him to the Iron and Steel Institute in 1888, and to the Institution of Mining Engineers in 1901 In the course of the recent revision of the Carboniferous areas of the Lothians by the Geological Survey, Mr Wilson obtained much further information Among the more important results are the determination of the outcrops and lines of fault owing to the recent mining developments in the Tarbrax, Cobbinshaw, Pumpherston and Breich fields, and the mapping of the new shale field at Ingliston The recent discovery of valuable oil shale near Duddingston may have a vital bearing on the future development of the industry The importance of the industry in Scotland is shown by the fact that in 1904 a total of 2,332,000 tons of oil shale was mined, yielding 62,932,000 gallons of crude oil, from which was produced 2,517,000 gallons of naphtha, 17,000,000 gallons of illuminating oil, 38,000 tons of gas oil, 39,500 tons of lubricating oil, 22,500

tons of wax, and 49,600 tons of sulphate of ammonia The coloured geological map and the sections accompanying the memoir are excellent, but the illustrations in the text are crude and roughly reproduced

In the *Electrician* of January 11 is an interesting article by Mr. G W Pickard on the measurement of received energy at wireless stations, reprinted from the *Electrical Review* of New York which should appeal to all who are watching the development of wireless telegraphy The method described by the author is both simple and useful, and does not require an elaborate arrangement of instruments A telephonic mode of reception is employed, and the sound of a single spark at the sending station is reproduced in the telephone by the discharge of a local condenser through the same receiving circuits, the charging potential of the condenser being made equal in intensity by variation until this is accomplished The periodicity of the condenser discharge is the same as that of the received energy Then knowing the potential and capacity of the condenser, the energy can be deduced by a simple formula An objection to the method is the difficulty in comparing successive sounds, which cannot be accomplished with any degree of accuracy Also a slight change of spark-length at the sending station would seriously affect results, and therefore make comparisons of the sending station's performance from day to day almost impossible The author mentions a method by which this may be partly overcome by the insertion of a key in the detector circuit, so as to secure the sending of a truly single spark At the same time, the method described will be useful as a rough test in practical work, and should help towards the solution of a true formula for long-distance work

We have received from Mr I A Vaughton, Sutton Coldfield, a communication entitled "'Growing' Alumina," which gives particulars of phenomena observed during the passage of electric sparks between a globule of mercury, acting as anode, contained in a drawn-out capillary tube placed vertically a few millimetres above an aluminium plate, which serves as kathode While sparks are passing, a circular "crater" composed of nearly pure alumina in a light, feathery form grows round the sparking spot, and after a short time the quantity of the product formed is considerable In appearance it resembles moss, when examined with a lens during its formation, filaments are seen to shoot along the surface of the aluminium in definite directions If the sparking be stopped and the deposit removed, the formation of the moss again occurs without the current being necessary, and the process may be repeated several times in succession In an atmosphere of hydrogen no alumina is formed, and in oxygen but little growth occurs The alumina produced acts on a photographic plate even through celluloid A contributor to whom we have submitted the communication informs us that the phenomena are probably due to the formation of aluminium amalgam owing to mercury being sprayed upon the plate by the sparks It is decomposed by atmospheric moisture, giving alumina and mercury, which is free to repeat the process Little action occurs in oxygen because of the need of a supply of water vapour The photographic action occurs owing to the production of hydrogen peroxide, which will attack a photographic plate through celluloid, hydrogen peroxide is generally formed in similar oxidations

The Memoirs of the Liverpool School of Tropical Medicine, twenty-one of which have been published, are to be superseded by a periodical which is to be issued by the school under the title of *Annals of Tropical Medicine and Hygiene* The annals will be edited by Prof Ross, in collaboration with Drs Stephens, Todd, Thomas and Breinl, Mr Newstead, and Sir Rubert Boyce

The report on the scientific results of the voyage of the S Y *Scotia* is to be published in six quarto volumes by the Scottish Oceanographical Laboratory The first volume will contain a narrative of the voyage and a summary of results, the second will deal with the physical results of the expedition, the third with botany, geology, and cartography, and vols iv v, and vi with the numerous branches of zoology The work will be fully illustrated with maps, plates, and photographs Each volume will consist of several parts, which will be published separately when ready Vol ii will be issued first, and will be ready immediately It will consist of five parts, dealing respectively with meteorology, magnetism bathymetry, physics of the ocean and tides and waves Orders, accompanied by a remittance for vol ii, 42s should be sent to the director Scottish Oceanographical Laboratory, Surgeons' Hall, Edinburgh

OUR ASTRONOMICAL COLUMN

The Temperature of the Moon —In a paper appearing in the *Astrophysical Journal* (No 5, vol xxiv), Mr F W Very discusses Mr Coblentz's recently-published conclusion that, from an investigation dealing with the reflection of heat radiations from various mineral substances, it may be deduced that the apparent temperature of the lunar surface is chiefly due to reflected solar radiations, and that the *actual* temperature may be about −225° C, in accordance with Langley's first conclusion Mr Very points out that his investigations of the radiations show that the larger part of them are not merely specularly reflected, but are radiated, the moon having first absorbed the heat from the solar radiations Instead of −225° C he suggests that the temperature of the lunar body may reach a maximum of about 100° C, the corrected lunar-radiation curve being similar to that appertaining to bodies not much below the temperature of boiling water

The Helium Line, D_3, in the Solar Spectrum —In a communication to the *Observatory* (No 379) Mr Buss of Ashton-on Mersey, states that he has repeatedly seen the helium line, D_3, as a dark line, when examining parts of the solar disc, within the sun spot zone, on which there were no telescopic signs of unusual activity He has previously recorded the appearance of this line in the region of various spots but never in the spot umbra itself and thinks that it might be found very often if continuous observations were made for the purpose He also suggests the possibility of D_3 being a regular feature of the Fraunhoferic spectrum the line being too fine to be seen with our present instruments except on occasions when the region examined is subject to some slight disturbance

A White Spot on Jupiter's Third Satellite —In No 4147 of the *Astronomische Nachrichten*, Senor José Comas Solá, director of the Fabra Observatory records the observation of a white spot near the north pole of Jupiter's third satellite on November 23, 1906 The observation was made with powers of 450 and 750 on an equatorial of 38 cm aperture, and with the latter magnification the spot was seen, with great facility as being intensely white and bordered by a very dark area Senor Solá thinks that much smaller instruments may reveal this feature With a steady image other, dark spots were seen, the whole disc of the satellite appearing as a reduced image of Mars The observation was made between 13h and 14h 15m, but no displacement of the spot was detected

A Remarkable Nebula —On some plates taken during September, 1906, Prof Max Wolf has found an extended nebula near to the star 20 Ceti Practically all extended nebulosities are situated in or near to the Milky Way, but this is a remarkable exception, for it is removed some

70° from the plane of the galaxy, the position of its densest part being $\mathrm{RA} = 0^{h}\ 57{\cdot}4^{m}$, dec $= +1^{\circ}\ 20'$ (1885).

This nebulosity is also remarkable in appearance; around the densest region there extends a quantity of nebulous matter of varying intensity showing small clouds of increased intensity at several points. Further out the intensity becomes so feeble that it is impossible to define its limits, and Prof. Wolf expects that a longer exposure than the four hours which he gave may materially extend the nebulosity seen on the plate. Three B.D. stars are involved in the cloud, which extends about 40′ in declination and 30′ in R.A. When examined under the microscope the brighter parts of the image are filled with numerous minute spots and short trails, and Prof. Wolf thinks it possible that the cloud may consist of a multitudinous congregation of very small planetary nebulæ, which a more powerful instrument may be able to resolve. The present plates were taken with the 16-inch Bruce telescope (*Monthly Notices*, November, 1906).

PERIODICAL COMET DUE TO RETURN IN 1907.—Only one periodical comet is due to return during the current year, that discovered by Giacobini at Nice on December 20, 1900. As observed then it was very faint, and showed only a small nebulous disc, without any tail. As its period is about seven years, according to the elements calculated by Prof. Kreutz, and as it passed through perihelion about December 3, 1900, it is not likely to be rediscovered until nearly the end of the present year (the *Observatory*, No. 379).

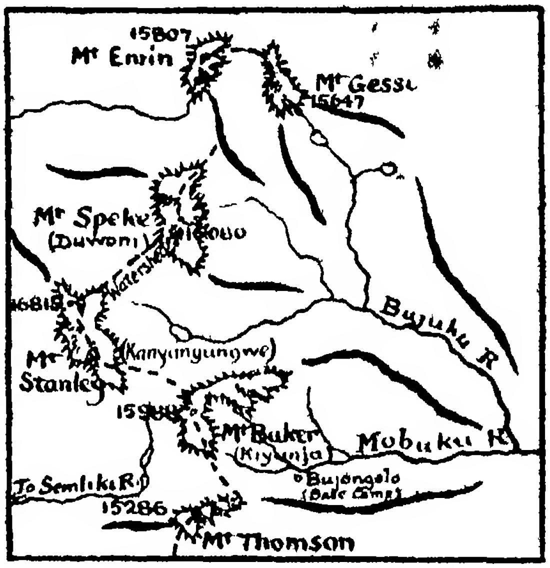
ORBITS OF THREE DOUBLE STARS.—The results of an investigation, by Prof. Doberck, of the orbits of ζ Cancri, ω Leonis, and H I 39 (Σ 3062), are published in Nos. 4144–5 of the *Astronomische Nachrichten*. The author gives a set of elements for the orbit of each system, and compares all the available observations with the calculated places; from a discussion of the whole he gives the probable error of the annual means of each observer's measures. According to the final elements, the respective periods of these three systems are approximately 60, 116.7, and 105.5 years.

THE DUKE OF THE ABRUZZI'S ASCENTS IN THE RUWENZORI RANGE.

AT a crowded meeting of the Royal Geographical Society, held at the Queen's Hall on January 12, and honoured by the presence of the King and the Prince of Wales, the Duke of the Abruzzi gave an interesting account of his recent exploration of the snowy summits of the Ruwenzori range. It will be remembered that many attempts on these peaks have been made within the past few years, but that, owing rather to the climatic character of the range and its distance from an accessible base than to special difficulties from a mountaineer's point of view, all the Duke's predecessors had failed to reach its culminating point. Profiting by the experience of these, the Duke was able to avoid the causes of their failure, his expedition being provided with all that forethought could suggest in the way of equipment, while he was also fortunate in securing trustworthy information as to the times of year at which the climatic conditions were likely to be most favourable.

The Duke was accompanied by two Alpine guides and two porters, all from Courmayeur, as well as by experts entrusted with research in various scientific departments, including Major Cagni, his trusty companion on his previous expeditions, and Signor Sella, well known for his unique experience in mountain photography. Apart from the mountaineering interest of the expedition, there was much to be done before the topography or morphology of the range could be at all thoroughly understood. Captain Behrens, of the Anglo-German Boundary Commission, had, by triangulation, fixed the altitude of the highest summit within very narrow limits, and shown that it was much under the 20,000 feet attributed to it by some travellers. He had also fixed with considerable accuracy the position of the double culminating peak, recognised as the Kanyangungwe of Stuhlmann, but the number and relative positions of the several *massifs* were still matters of uncertainty.

It is unnecessary to refer to the first part of the Duke's address, dealing with the journey from the coast and final organisation of the expedition. The route adopted (after much deliberation) for the approach to the snows was that from the east by the Mobuko valley, followed by Moore, Johnston, Grauer, and others. During the toilsome march up this the Duke saw reason to doubt its being the best, and he subsequently found that the Bujuko, a northern branch, or even the main head-stream, of the Mobuko, possessed some advantages. After the usual difficulties had been overcome, the snows were at last reached, and a view of all the peaks obtained from a ridge running east from Kiyanja. To the north, four distinct snowy mountains, separated by well-marked depressions, were in view, the nearest and most westerly being crowned by two pairs of peaks, the loftiest of which were at once recognised as those seen from Butiti both by Freshfield and the Duke, while evidently quite distinct from the Duwoni of Johnston. This had already been suspected by Mr. Freshfield after receiving the account of Mr. Wollaston's ascents. After ascending to the summit of Kiyanja it was decided to make a circuit to the south of this mountain, and after descending into a valley belonging to the



Rough Sketch of the Ruwenzori Peaks.

Semliki system, to strike north for the saddle between the two highest peaks. During the descent of this valley a striking sunset view over the great Congo forest was obtained, and the Duke's description was well reinforced by one of Signor Sella's striking photographs. The ascent was successfully accomplished by the Duke and the guides on June 18, the chief difficulty arising from the mists and from an overhanging cornice, which required great care to negotiate. A peculiar feature was the presence of huge "ice-stalactites," which supported the cornice. The twin peaks received the names of the Queens of Italy and England. Between June 22 and July 10 the Duke ascended all the main peaks, while his coadjutors prosecuted their own several tasks, Major Cagni completing an excellent map, while Signor Sella pursued his photographic labours, of the admirable results of which the audience had many specimens.

To the individual *massifs* and peaks the Duke has given the names of distinguished explorers of the region and of Royal personages, although it may be doubted by some whether the native names which have already found their way into Ruwenzori literature are not more in harmony with the romantic aloofness of the range than any exotic appellations, however otherwise suitable. Even though not strictly belonging to the summits, the native

names might as legitimately be transferred to the latter as many of the names in use in the Alps and elsewhere. An interesting point brought out is the fact that all the snowy massifs lie on the main water-parting of the range. As regards its geology, the theory of a volcanic origin may be absolutely excluded, there being only one spot in the whole upper region at which even local traces of basaltic veins were seen. The evolution of the range may be ascribed to (1) an upheaval *en masse* of a portion of the Archæan floor of Central Africa; (2) to a highly accentuated anticlinal uplift, ellipsoid in form, with strata more or less tilted in the central group; (3) the presence in this of a series of rocks (amphibolites, diorites, &c.) far more resistant than the gneisses and mica-schists of the outer ranges. Evident traces were seen of the enormous development of glaciers in the Ice age, while at present they are of the second order only, on the upper slopes and in the larger ravines. They are all at the present moment in retreat. The snow-line seems to be at about 14,400 feet. Among other results of the expedition, various new species of birds, molluscs, insects, crustacea, &c., were collected, though the *fauna* of the upper region was naturally poor.

The Duke showed a praiseworthy caution in identifying the range with the "Mountains of the Moon," in spite of the obvious allurements of the notion, to which so many of his predecessors have succumbed.

At the conclusion of the address the King, in a short speech, expressed the thanks of the assembly to the Duke, whom he congratulated upon his successful expeditions in tropical and polar regions.

METEOROLOGY IN PERU.[1]

IN 1892 Prof. W. H. Pickering and others of the staff of the Arequipa Observatory were trying to establish meteorological stations in Peru, a region which up to the present has not been very well represented in meteorological observations. The meteorological station at Mollendo had been discontinued during 1890 and 1891, but observations were resumed there and at Arequipa during the early part of 1892, and in March a station was established at La Joya, a town midway between these two places.

In December, 1891, Messrs. Douglas and Goodair made a journey of inspection past the Chachani Ravine, behind Arequipa, and ascended the main Chachani summit to an altitude of 18,000 feet, being satisfied that the ascent could be completed. In January, 1892, Prof. Pickering established a station at the Chachani Ravine at an altitude of 16,650 feet. An attempt was made in December to start a station on the main summit, but when Prof. Pickering and Mr. Goodair reached a height of 18,800 feet the Indians who were carrying the instruments and baggage deserted, and the attempt failed. The Chachani Ravine station was visited about once a month during 1892, and discontinued in 1893.

In October, 1893, a station was erected on the summit of the Misti Volcano, and in December another lower down on the eastern flank, the altitudes being 19,200 feet and 15,600 feet respectively. In 1895 observations were also taken at an altitude of 13,300 feet.

These stations constituted a chain from the sea coast over the western Cordilleras, and in order to continue this chain across the Andes, Prof. Solon I. Bailey, in July, 1894, started a station at Cuzco, in the valley between the western and eastern Cordilleras. The instruments were established in the yard of a brewery, and one of the employees commenced observations in July.

The Meteorological Station at the Chachani Ravine (16,650 feet).

After an unsuccessful attempt to secure a station to the east of Cuzco, Prof. Bailey went on northward, using mules and encountering many difficulties on the way. Very often the shelters and instruments had to be carried by hand under the low branches of trees and overhanging rocks which would otherwise have struck them from the backs of the mules. At Santa Ana Prof. Bailey met one of the estate owners, who willingly agreed to make the observations in his own grounds, and did so for more than a year.

The various stations were all fitted with Richard barographs and thermographs, standard and maximum and minimum thermometers, &c. Observations were also made of rainfall, clouds, winds, and of occasional phenomena.

At Mollendo, La Joya, and Cuzco observations were made at 8 a.m., 2 p.m., and 8 p.m. each day, but at Santa Ana only at 8.0 a.m. At the mountain stations observations were made only at intervals of about ten days by various members of the Arequipa staff.

In the volume under notice only eye observations have been discussed, the automatic records being left for a future volume. So also are all the Arequipa records.

An examination of the thermometer records shows that the annual range of mean temperature at the lower stations is small, being largest at Mollendo on the coast.

[1] "Annals of the Astronomical Observatory of Harvard College." Vol. xxxix., part ii., Peruvian Meteorology, 1892-5. By Prof. Solon I. Bailey.

where the range is from 59°·9 F, in August, to 71°·6 F, in February, only 11°·7 F, whilst at Cuzco the range is only 6°·1 F.

At Mollendo and La Joya, both west of the mountains, the south and east winds predominate very largely, whilst at Cuzco and Santa Ana there is no marked preponderance of wind from any particular quarter.

During the period April, 1892, to December, 1895, the total rainfall at Mollendo was 2·65 inches, the mean annual rainfall being 0·66 inch. At La Joya, which is in the middle of the desert of Islay, no measurable rain fell during the whole period, that is, never did more than one two-hundredth of an inch fall on any one day. On the average there are eight days per year on which some rain falls. The annual rainfall at Cuzco is 38·58 inches, and the rainfall for the year July, 1894, to June, 1895, at Santa Ana was 51·71 inches.

All the observations made by eye are given in full, and are well summarised. The dated remarks which accompany the tables prove very interesting reading, especially those referring to the high stations, and show well the difficulties encountered in making observations at these altitudes, exposed to wind and cold, and apparently also to robbers, for on September 6, 1894, it is recorded that at the Misti summit station the doors of the hut and shelter were found open, and that the barograph, thermometers, and tools had been stolen!

As an appendix an account is given of the moving sand dunes of the desert of Islay. Scattered over this desert are thousands of these crescent-shaped dunes. They are all of one form, and have always the same orientation, with the convex side to the south winds and the cusps pointing north and north-west.

Prof. Bailey measured one of these dunes near La Joya in 1894. The points were 160 feet apart, and the length round the convex side was 477 feet. Its maximum width was more than 100 feet, and the weight was estimated as more than 8000 tons.

Between March, 1892, and March, 1894, it had travelled 125 feet, and by March, 1896, a further 120 feet. From that date until January, 1901, monthly measures were taken, and in the five years it travelled 294 feet at an average rate of more than 5 feet per month. A comparison of the record of movement and the record of strong south winds shows that these winds are the sole cause of the northerly movement of these sand dunes. W. M.

THE ASSOCIATION OF ECONOMIC BIOLOGISTS.

ON Wednesday, January 9, the annual meeting of the Association of Economic Biologists opened at Cambridge, and continued until Friday, January 11. The conferences were held by kind permission of the medical staff in the pathological department of the University, and the laboratories in this department and also the zoological laboratory were thrown open for the occasion, and members also had the opportunity of visiting the botanical department.

Mr. A. E. Shipley, F.R.S., was elected president of the association for 1907 in the place of the retiring president, Mr. F. V. Theobald, who with Sir Patrick Manson, K.C.M.G., and Prof. W. Somerville, will act as vice-presidents for the year.

In his presidential address Mr. Shipley dealt with the subject of sea fisheries. He gave an interesting account of this important subject, and dwelt on the necessity of constant investigation. No less than 27,000 vessels are engaged in this industry, employing 90,000 men, fishing from British ports, the capital invested being estimated at 11,000,000*l*. He referred to the partial failure of the herring fishery last summer, and to the numerous inquiries that had been held concerning such matters, recounting no less than seventeen in the last seventy years.

The president is of opinion that time is not yet ripe for deep-sea fishing legislation, on account of our knowledge still being so deficient that it does not yet form a sound basis for law making. The North Sea fisheries are those upon which our energies must be mainly expended. Fishermen and experts have long held that the grounds are being depleted, and the latest report of the Board of Agriculture and Fisheries bears out these statements.

Mr. Shipley then mentioned various experiments that had been carried out in Norway and on the Dogger Bank. Some interesting figures regarding fish reproduction were quoted, showing their enormous sexual powers, for instance, the turbot produced annually 8½ million eggs and the cod 4½ million.

The chief possible causes of impoverishment were summed up as follows:—(1) the accumulated stocks of the Dogger and Iceland grounds had been fished out; (2) any given area of sea could support but a limited quantity of produce; and (3) the excessive destruction of young fish. In spite of the grave nature of the North Sea problem, it is satisfactory to learn that the condition of the fishing industry generally was never more prosperous than at the present time. It is hoped that sufficient funds will be forthcoming to continue the excellent scientific work in this subject that has already been done.

Prof. Nuttall's paper on red-water fever and allied diseases was full of interesting matter. After explaining the results of his investigations into the life-history of the Piroplasmæ he dealt with the various diseases caused by them, dwelling particularly on the results of his experiments on canine piroplasmosis. In connection with this paper Prof. Nuttall and Mr. Warburton had prepared a most interesting exhibition of ticks, and the parasites they convey.

The first day's proceedings finished with a paper by Mr. R. H. Biffen on his well-known work on cereal breeding.

The first paper on Thursday was one by Mr. F. V. Theobald on some new hemipterous fruit pests. Illustrated by lantern-slides, the life-history and damage caused by leaf-hoppers (Typhlocybidæ) were fully entered into. There had been no complaint of these insects by fruit-growers until last year, when some species occurred in such numbers that they even stopped picking. Besides mentioning results obtained in the treatment of these pests, Mr. Theobald discussed the parasites which affect the Typhlocybidæ, amongst the most interesting being some small Proctotrupids which cause "parasitic castration," one genus, Aphelopus, having occurred during the past year in such numbers that the opinion was expressed that the "hoppers" must have been nearly stamped out in places.

A long paper followed on the American gooseberry mildew, by Mr. Salmon, who explained its life-history and the great damage it does, and dwelt upon the necessity of immediate steps being taken to stamp it out and prevent importation. The paper caused some discussion, in which Profs. Middleton, Percival, and Fisher joined.

The secretary (Mr. Collinge) then gave a short and concise description of his successful extermination of the black-currant gall mite by means of sulphur and lime. Dr. MacDougall read a paper on parthenogenesis in the pine sawfly, and then gave an account of an extremely interesting piece of work on the length of life of *Calandra granaria*. At the afternoon sitting Mr. Freeman dealt with the geographical distribution of rubber plants, and incidentally stated that the output last year was 70,000 tons, valued at 30,000,000*l*. Of this, 63 per cent. came from tropical America and 34 per cent. from tropical Africa, the remainder from Asia, the output of cultivated rubber being only 1½ per cent. to 2 per cent. of the world's output.

Mr. E. R. Burdon then read a paper on the spruce-gall and larch-blight diseases caused by Chermes, and traced the connection between the two aphides and their migrations.

The day's proceedings terminated with a paper by Mr. F. V. Theobald on the insect pests of the British East Africa Protectorate, giving an account of the chief insect pests received from the Imperial Department of Agriculture. The most interesting is the diamond-back moth, which is thought to have been introduced into Africa, but which Mr. Theobald believes to be indigenous, in which Prof. Carpenter entirely agreed.

The final sitting was held on Friday morning, January 11, when papers were read by Mr T Strangeways, on a description of an infectious disease occurring in hares, by Mr E. G Fearnsides, on the blood changes in man caused by the presence of metazoan parasites, and their aid in diagnosis, and the use of an economic museum in the teaching of geography, by Mr W G Freeman Some valuable observations were brought out in Mr Fearnside's paper on the changes observed in the blood in parasitic attacks and the production of toxins by the parasites Mr Warburton exhibited an apparatus for extracting small mites, &c, from moss, invented by Prof Berlese, who contributed a paper on the olive-fruit fly and its treatment

The next annual meeting will take place at Edinburgh in Easter, 1908, a meeting was also arranged for July in London

Mr Walter Collinge, of Birmingham University, is still continuing the secretaryship

THE PUBLIC SCHOOL SCIENCE MASTERS' ASSOCIATION

THE annual meeting of the Public School Science Masters' Association was held on Saturday, January 12, at the University of London, the president, the Rev and Hon E Lyttelton, headmaster of Eton, being in the chair

The president, in his address on the place of science and of literature in a general education, prefaced his remarks with the opinion that a classical headmaster had one great advantage when criticising a science lesson in that his total ignorance of the subject placed him in the position of the most backward of pupils, and enabled him to ascertain exactly when the lesson was successful in producing the required impression on the mind of the learner In the discussion of educational matters there were the dangers of cloudiness from ignorance and of dogmatism which afforded no contribution to the discussion Science was calculated to diminish these two dangers By science he meant experimental study, and not the form of class demonstration sometimes, in the old days, combined with lax discipline, the object apparently being to provide a sort of agreeable change in the regular work of the schoolboy

As now understood, general education meant that given to boys up to the age of sixteen, and the arguments following were in favour of science being taken seriously before that age It would be conceded that science aroused more interest, at least in its initial stages, than was the case with any other subject, save religion, but it was a question whether this interest did not fall off later when more brain work was required This was so with classics The practical question, however, was not whether science interested the boy more than did the classics, but whether science and literature should go on together The boys who were apparent failures at classics might be found successful later in science Huxley had said that in science young minds were brought into contact with facts It was not so very different in the case of literature The advantages claimed for science in educational effects, training in inductive and deductive methods, and freedom from following mere authority, were shared by most other subjects when these were taught by modern methods These newer methods were certainly due to the influence of science teaching

The advantages of experimental science might be said to consist in the constant application to reason, truth, the senses of touch and sight, the virtue of patience and accuracy Science brought the pupil into association with the great army of discoverers, and illuminated daily life with its stimulating powers, leading to the exercise of the precious faculties of imagination and wonder The president pleaded for training leading to ambidexterity, and referred to the healthful mental effect afforded by exercise of both sides of the brain, pointing out that many school games were lacking in this respect The results of scientific and of literary teaching both depended upon the enthusiasm of the teacher, but this was especially true of the latter One advantage of literature was that it brought the learner more into contact with human affairs generally and although some of the faculties touched were the same as in the case of science, there were others not so influenced They were not called upon to decide between two subjects There was room for both, teachers of science and of classics should be co-workers Literary teachers should be able to save the science masters the labour of teaching the art of making notes in correct style The classical failures should be rescued by science The classical teacher called to the science teacher for help with new devices to touch the imagination and awaken hope—for something to haunt startle, or waylay the young minds, to make them feel the joy of learning

Sir Oliver Lodge said that to eliminate the heat retained rather than generated by cloudiness of thought and fog of dogmatism, it was necessary to admit the clear and bracing atmosphere of science He agreed that ambidexterity was to be encouraged There were three kinds of boys, the docile, the eager, and the unwilling, each of whom required different treatment But it was necessary to consider the average boy The quantitative side of science should not be overdone In that respect subjects differed, in the study of heat, quantitative work was desirable in the earliest stages, but in electricity he thought it better at first to allow an acquaintance with phenomena, proceeding later to measurement The teacher should excite interest rouse curiosity, feed only the hungry, and not stuff with information *apropos* of nothing Sir Oliver suggested that astronomy and physiology might be taken in schools, and that astronomy should be treated in a manner not too technical, but rather on biographical lines One should begin at both ends of a subject, but in different ways, for science was both inductive and deductive and this method of learning would use both qualities He advocated the pupil's going "behind the scenes", he should read examination answers, perhaps set examination papers In learning a language a boy was apt to consider he was dealing with chaos so many forms of words occurring *e g* changes in stem of verbs, for which he could see no reason Were the boy set to construct a language, he would see the necessity for and realise the meaning of tenses and cases Boys should be encouraged to read the classics of science and then they would get to appreciate the spirit of scientific investigation, which should be carried into all their studies Books should be used in order to learn how to acquire knowledge at first hand, problems should be thought out before information was gratuitously supplied A literary education was possibly best on the psychical side, but it did not give a knowledge of the material universe and no educated person should be deprived of this

Prof Tilden thought the system of classical and scientific sides in schools was insufficient There were, for instance, artistic minds which did not respond to either of these divisions The president, replying to Mr J Talbot (Harrow) said he agreed that science should have a liberal allowance of time in the curriculum something quite different from simply two hours per week, and in reply to the Rev A L Cortie, S J (Stonyhurst) he advocated commencing the subject at, say six or seven years of age Mr Thwaites (Wyggeston Schools Leicester) gave the results of some inquiries he had made of the chief public schools In general, about 60 per cent of the boys take science, and of these about 95 per cent are in the general courses The average number in classes was 21 5 for the general and 14 for special courses The former were allowed, on the average four hours per week for two subjects and the latter twelve hours In twenty three schools there was one science master for every twenty six boys He considered it was now time for the schools to agree upon the subject-matter of their science courses

Mr F R Leyland-Wilson (Charterhouse) read a paper on the best method of introducing the atomic theory in science

An exhibition of apparatus by members and manufacturers was held at the close of the meeting

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MR EVAN SPICER, chairman of the London County Council, will distribute the prizes and certificates at the annual conversazione of the Northampton Institute, Clerkenwell, E C, on Friday, January 25

THE annual general meeting and dinner of the Central Technical College Old Students' Association will be held at the Trocadero Restaurant, Piccadilly Circus, W, on Saturday, February 23 Applications for tickets should be sent to Mr R J Caldwell, 40 Salehurst Road, Crofton Park, London S E

THE department of archæology of the University of Pennsylvania has received a gift of 8000*l* from Mr Eckley Brinton Coxe, jun The donor has specified that of the gift 1720*l* a year shall be paid for five years to the new curator of the department of Egyptology Dr D Randall MacIver, who is now in Egypt, where he has been instructed to begin excavations

MR SIDNEY WELLS, principal of the Battersea Polytechnic and a member of the consultative committee of the Board of Education has been appointed Director General of the Department of Agriculture and Technical Education for Egypt This department has been created in order to develop, organise, and control technical education in Egypt generally It will be concerned with all the Government educational institutions of every kind, and also with the non-Government technical institutions

A PRIVATE donation has enabled the Meteorological Committee to invite applications for an appointment as reader in dynamical meteorology The readership will be of the annual value of 350*l*, and will be tenable for three years at any British university that may be approved for the purpose and affords the required facilities The duty of the reader will be primarily to promote the science of meteorology by mathematical investigation, and he will be expected to give annually a short course of about twelve lectures Further details may be obtained from the Director of the Meteorological Office, 63 Victoria Street, London, S W

THE annual report of the council of University College, London, has just been issued The number of students in the college for the session 1905–6 was 1396, of these, 134 were post-graduate and research students The report contains particulars of the benefactions received during the year, which include valuable grants from the Drapers' Company from the Chadwick trustees, and the sum of 2500*l* collected by the Jewish Historical Society for the maintenance of the Mocatta library The report also contains a summary of the research work done during the past session, the lists of the publications by professors, assistant teachers, and senior students occupy fourteen pages The steps that have been taken for the union of the college and the University of London are summarised in the report On January 1 of the present year the college ceased to be a school of the University, and became incorporated with it, thus realising the aims of those who in 1826 founded it It is the first college to be thus incorporated with the University, and it is understood that its example will be followed by King's College Important additions have been made during the past year to the departments of physics and chemistry, and a plan has been worked out for the rearrangement of many of the college departments This will be possible when the new buildings for the school of advanced medical studies, now in course of erection by the generosity of Sir Donald Currie and the new buildings of University College School at Hampstead, are completed

SOCIETIES AND ACADEMIES.

LONDON

Mathematical Society, January 10.—Prof W Burnside, president, in the chair —An exhibition of models of four-dimensional figures was made by Mrs A **Stott.** The models are sections by three-dimensional flat spaces of the six regular hypersolids of a flat space of four dimensions The sections are in general polyhedra, and corresponding faces of different polyhedra, forming a series of sections of the same regular hypersolid, are coloured identically, in order to show the relations between the different sections. Other models show the grouping about a point of the regular hypersolids which have the space-filling property —The uniform convergence of Fourier's series Dr E W **Hobson** The coefficients of the Fourier's series determined by an assigned function are defined by integrals, which may be determinate when the extended definition of integration introduced by Lebesgue is used, although they have no meaning when integration is interpreted in accordance with Riemann's definition It is shown in the paper that whenever the coefficients of the Fourier's series, determined by a function $f(x)$ in the interval $\pi > x > -\pi$, are, in this sense, determinate, and the function $f(x)$ is continuous throughout a sub-interval included in this interval, and this function is of limited total fluctuation in the whole interval the Fourier's series so determined converges uniformly in the sub-interval —Hyper-even numbers and Fermat's numbers Lieut-Colonel A **Cunningham.** The hyper-even numbers are formed in sequence as 2^n 2^{2^n}, $2^{2^{2^n}}$, and so on. Fermat's numbers are of the form $2^{2^n}+1$ The numbers ξ which are such that $2^\xi \equiv 1 \pmod{m}$ are the *Haupt-exponents* of 2 for the modulus m The paper is occupied with tracing the relations which connect together the residues of successive hyper-even numbers, the uneven factors of the *Haupt-exponents*, and the Fermat's numbers —Riemann's hypergeometric function Dr E W **Barnes.** It is shown how the differential equation of the hypergeometric series, and likewise that of Riemann's function, can be solved respectively by means of certain contour integrals, and how the known solutions can all be obtained by deforming the contour The relations between the various forms of solution, which hold in the neighbourhoods of the singular points, can be traced very simply by means of the general formulæ The method is applied to obtain asymptotic approximations to zonal harmonics in the case where the index increases indefinitely —Partial differential equations of the second order, having integral systems free from partial quadratures Prof A R **Forsyth** The integral systems discussed are those in which three variables x, y, z are expressed in terms of two parameters u, v, an arbitrary function of u, an arbitrary function of v, and differential coefficients of these two functions The object of the paper is to determine the forms of the differential equations which possess integrals of the type in question and to construct the integrals of such equations —The singular points of certain classes of functions of several variables G H **Hardy** The theory of the singularities of functions of one variable, defined by Taylor's series, may be said to be tolerably complete, but in the case of functions of several variables little advance has been made The purpose of this paper is, by the consideration of a few of the simplest cases, to make a beginning with the problem of classifying types of power series in two or more variables according to the nature of their singularities —The singularities of functions defined by Taylor's series G H **Hardy**—Asymptotic approximation to integral functions of zero order J E **Littlewood** —The reducibility of covariants of binary quantics of infinite order P W **Wood.**—The forms of the stream lines due to the motion of an ellipsoid in infinite fluid, frictionless or viscous Dr T **Stuart.**

Geological Society, December 19, 1906 —Sir Archibald Geikie, Sec R S, president, in the chair.—The post-Cretaceous stratigraphy of southern Nigeria J **Parkinson.** In this paper, which is a first attempt to outline the sequence of the later deposits of southern Nigeria (now including the colony of Lagos), a series of beds is described from four localities—three from the western side of the Niger, and one around Calabar near the Kameruns frontier The alluvium of the river-beds and the lower terraces are referred to, and the succeeding sediments grouped under three heads —The geology of the Oban Hills (southern Nigeria) : J **Parkinson.** The country described in this paper comprises some 1800 square miles of the Eastern Province of southern Nigeria, adjacent to

the Kamerun frontier The rocks are crystalline, principally gneisses and schists, with later granites, pegmatites, and basaltic dykes, surrounded on the north, west, and south by Cretaceous sediments. For purposes of description the series is divided under nine headings, according to locality and petrographical character, and it is concluded that, neglecting the basaltic dykes, two broad groups may be distinguished—the one characterised by the presence, the other by the absence, of foliation In the former the foliation tends to be lost, giving a passage between types which petrographically are acid orthogneisses and granites.—The crystalline rocks of the Kukuruku Hills (Central Province of southern Nigeria) J **Parkinson** In this paper a short account is given of the crystalline rocks found in the Central Province of southern Nigeria, between the station of Ifon (north of Benin City) and the northern Nigerian frontier The rocks fall under two heads —(*a*) a group of gneisses, and (*b*) a group of schists

Royal Microscopical Society, December 19, 1906 —Dr D H Scott, F.R S, president, in the chair —Microscopic study of strain in metals F **Rogers**. The author described the nature of the fatigue of steels which is brought about by submitting them to alternating stresses of a certain magnitude The nature of the effects in the ferrite of steels is different from that in soft iron, and the effects in pearlite depend upon the type of pearlite An important difference exists between steels as rolled, or annealed below about 750° C, and steels annealed at higher temperatures, i e more or less overheated In the former, the outcrops of surfaces upon which slip has repeatedly occurred are very numerous, short and crooked, and the surface parallel to the direction of stress becomes ruffled In the latter type, the outcrops are fewer, less crooked, and longer, and the surface is practically unruffled A relation is found to exist between the ruffling and the Lüders's lines which are found upon statically-strained pieces, and this leads to the theory that specimens of the "normal" group endure fatigue better than "overheated" specimens, because the permanent and injurious microscopic strains are more minutely subdivided and uniformly distributed in the former than in the latter There is a stage in the life of a piece of steel enduring fatigue, after which, though it is far short of final rupture, annealing is futile, if not actually harmful Pieces in this stage if heated to 250° C or higher, and then fatigued to rupture, show heat-tint marks on the ultimate fracture, which map out the portion of fracture which was sufficiently open at the time of heating for air to enter

PARIS

Academy of Sciences, January 7 —M A Chauveau in the chair —The distillation of alloys of silver and copper silver and tin, and silver and lead Henri **Moissan** and Tosio **Watanabe**. Alloys of the above-named metals were heated under comparable conditions in the electric furnace, the current being maintained at 500 amperes at 110 volts The original alloy was analysed, and also the ingot remaining in the graphite crucible after the heating It was found that the metal most easily volatilised was lead, followed by silver, copper, and tin, tin having the highest boiling point of the four The results are in general agreement with the experiments of Krafft on the distillation of small quantities of metals in a kathode vacuum —The results of the micrometric measurements made during the eclipse of August 30, 1905 at Roquetas and at Saint Genis Laval Jean **Merlin** The value adopted by Newcomb for the constant of lunar parallax is not appreciably in error, and a better value cannot be deduced from the above observations A certain number of the relative positions of the sun and moon given in the *Connaissance des Temps* require correction —A theorem of Heine and a theorem of Borel A **Schoenflies**.—Turbines with a flexible axis L **Lecornu** In high-speed impact turbines of the Laval type there are certain advantages connected with the use of a flexible axis The present paper is concerned with the effects of this flexible axis upon the movements of the centre of gravity of the system, taking into account the small variations of the angular velocity of the turbine disc —The theory of the magnetic properties of iron beyond the temperature of transformation Pierre **Weiss**.—The measurement of the radio-chromometric degree by the electrostatic voltmeter in the utilisation of the Röntgen rays in medicine J **Bergonié**. The voltage of the Crookes's tubes being measured by an electrostatic voltmeter indicating up to 60,000 volts, it was found that whatever the intensity of the current traversing the tube if the voltage measured by the voltmeter was kept constant, the rays emitted by the tube are always sensibly of the same radio-chromometric degree For increased voltages of the tube the rays become more penetrating the variable intensities of current passing through the tube being without effect Finally for tubes of different patterns, unequally used and carrying different intensities of current provided that the voltages are kept equal the radio-chromometric degree of each is the same —The ultra-violet phosphorescent spectrum of fluorspar The variations of the phosphorescent spectrum of the same element in the same diluent G **Urbain** and C **Scal** The phosphorescence spectrum of an element cannot be considered as constant, but depends on the proportions in which it is present in the diluting medium —The chlorination of organic compounds in the presence of thallous chloride V **Thomas** The results obtained by the substitution of chloride of thallium for ferric chloride as a catalytic agent in chlorination are not essentially different in the two cases, complex mixtures being found —The alkaline reduction of *p*- and *m* nitrobenzophenone P **Carré** The complete reduction with zinc dust and caustic soda is not possible without affecting the ketonic group the mixture of azo and azoxybenzophenone resulting from this reduction furnished *p* hydrazobenzophenone on treatment with ammonium hydrosulphide —The use of polarised light for the detection under the microscope of starches composed of rice and maize in wheat flour G **Gastine** An improvement of a method proposed in an earlier paper —Fluorine in mineral waters P **Carles** The author has improved his method for the detection of traces of fluorine in mineral waters and gives approximate determinations of the amounts present in ninety-three waters of different origin —Artificial growths Stéphane **Leduc**. An account of the influence of the medium in which the artificial cells are produced —The influence of temperature and the hygrometric state of the surrounding atmosphere on the preservation of eggs M **de Loverdo** The most favourable conditions for the preservation of eggs are a temperature kept exactly at −1° C, and a hygrometric state as near as possible to 78 per cent saturated —The annelids collected by the French Antarctic Expedition Ch **Gravier** —The origin of the centrosome J **Kunstler** —The regulation of the nycthemeral cycle of temperature and its inversion in the aged Ed **Toulouse** and H **Piéron** —The Cretaceous strata of the eastern Atlas in Morocco W **Kilian** and Louis **Gentil** —The value of the magnetic elements at the Val Joyeux Observatory on January 1 Th **Moureaux**

NEW SOUTH WALES

Royal Society, November 7 1906 —Prof T P Anderson Stuart, president in the chair —Notes on some native tribes of Australia R H **Mathews**. The author reproduced some information he had collected during many years past among the aborigines of different portions of the continent respecting their sociology laws relating to food methods of avenging deaths and so on He also briefly touched upon their language and some curious beliefs held by the natives concerning metempsychosis or reincarnation of souls —Note on the Silurian and Devonian rocks occurring to the west of the Canoblas Mountains near Orange New South Wales C A **Süssmilch** The area referred to comprises a large portion of the parish of Barton and a small portion of the parish of Bowan county of Ashburnam, and is about fifteen miles south west from Orange

CAPE TOWN

South African Philosophical Society, November 28 1906 —Dr J C Beattie, president, in the chair —Notes on the morphology and biology of *Hydnora africana* Thunb Dr **Marloth** The genus Hydnora comprises several species (about seven), which are confined to the African continent They are all parasites which grow on

the roots of different shrubs and trees The species which forms the subject of this paper, viz *Hydnora africana*, uses the common milkbush of the karroo and karroid regions of the interior, viz *Euphorbia mauritanica*, as its host It is in the structure of the flower that the author has observed some organ which has hitherto escaped the attention of botanists Each of the three segments of the perianth bears a large snow-white body on its inner side, while the remainder of the inner surface of the flower is of a bright flesh colour These three white bodies are not mentioned in any existing description of Hydnora — Examination of the validity of an approximate solution of a certain velocity equation Prof A **Brown.** The question here considered is the part played by the initial value of $y(\lambda)$ in the solution of the equation

$$\frac{dy}{dt} = a_1 y + a_2 y^2 + a_3 y + - - -$$

It is commonly assumed that, for a small initial value of y the method of successive approximation is applicable, the proviso being sometimes made that the value of y, so obtained be also small This assumption is shown in the paper to be not necessarily correct or in certain cases to lead to a rapid approximation when correct —List of Natal plants J Medley **Wood**

DIARY OF SOCIETIES

THURSDAY, JANUARY 17

ROYAL SOCIETY, at 4 30 —The Natural and Induced Resistance of Mice to the Growth of Cancer Dr F F Bashford, J A Murray and Dr W Cramer —On the Pathology of the Dropsy produced by Obstruction of the Superior and Inferior Venæ Cavæ and the Portal Vein Preliminary Communication Dr C Bolton —Observations on the Life history of *Adelea ovata*, Aimé Schneider, with a Note on a New Gregarine from the Gut of *Lithobius forficatus* C C Dobell

CHEMICAL SOCIETY at 8 30.—The Relation between Absorption Spectra and Optical Rotatory Power, Part I, The Effect of Unsaturation and Stereo isomerism A W Stewart —Organic Derivatives of Silicon, Part II, The Synthesis of Di-ethyl, Propyl Benzyl Silicol, its Sulphonation, and the Resolution of the Sulphonic Derivatives into Optically Active Compounds F S Kipping —The Association of Phenols in the Liquid Condition J T Hewitt and T F Winmill.—A New Mercuric Oxychloride J T Hewitt —Aromatic Selenonium Bases S. Smiles and T P Hilditch —The Relation of Colour and Fluorescence to Constitution A G Green —The Constitution of Silver Nitrite a Correction E. Divers —Preparation of Chromyl Chloride F D Law and F M Perkin —Tetraketopiperazine A T de Mouilpied and A Rule

ROYAL INSTITUTION, at 3.—Recent Advances in the Exploration of the Atmosphere Dr W N Shaw, F R S

LINNEAN SOCIETY, at 8 —*Platanthera chlorantha*, Custor, var *tricalcarata* W Botting Hemsley, F R S —Acanthaceæ of Insular Malaya the late Mr C B Clarke, F R S —A Freshwater Isopod from Calcutta Rev T R R Stebbing, F R S

INSTITUTION OF MINING AND METALLURGY, at 8 —Some Sampling Results E H Garthwaite —The Assay of Silver Bullion by Volhard's Method E A Smith —Water Skip with Automatic Discharge W R Francis.—Breaking Piece for a Swinging Jaw Rockbreaker G E Brown —A Visit to the De Beers Consolidated Diamond Mines E P Rathbone

FRIDAY JANUARY 18

ROYAL INSTITUTION, at 9 —Fifty Years of Explosives Sir Andrew Noble, Bart K C B, F R S

INSTITUTION OF MECHANICAL ENGINEERS at 8 —Adjourned Discussion on Lighting of Railway Premises Indoor and Outdoor H Fowler — Eighth Report to the Alloys Research Committee On the Properties of the Alloys of Aluminium and Copper Prof H C H Carpenter and C. A Edwards.

MONDAY, JANUARY 21

VICTORIA INSTITUTE, at 4 30.—The Scriptural Idea of Miracles Rev Canon Girdlestone

TUESDAY JANUARY 22.

ROYAL INSTITUTION, at 3.—The Sculpture of Aegina in Relation to Recent Discovery Prof Percy Gardner

ANTHROPOLOGICAL INSTITUTE at 8 30 —Annual General Meeting — Presidential Address The Burial Mounds and Dolmens of the Early Emperors of Japan Prof W Gowland

INSTITUTION OF CIVIL ENGINEERS, at 8 —Internal-Combustion Engines for Marine Purposes J T Milton

WEDNESDAY, JANUARY 23

SOCIETY OF ARTS, at 8.—The Isthmus of Panama Philippe Bunau Varilla

ENTOMOLOGICAL SOCIETY, at 8 —Annual Meeting

GEOLOGICAL SOCIETY, at 8 —The Geology of the Zambezi Basin around the Batoka Gorge (Rhodesia) G W Lamplugh, F R S With Petrographical Notes by H H Thomas

THURSDAY, JANUARY 24

ROYAL SOCIETY, at 4.30.—*Probable Papers* Experiments on the Dark Space in Vacuum Tubes Sir William Crookes, F R S —On a New Iron Carbonyl, and on the Action of Light and of Heat on the Iron Carbonyls Sir James Dewar, F R S., and Dr H O Jones.—Note on the Application of Van der Waals's Equation to Solutions The Earl of Berkeley —On the Presence of Europium in Stars J Lunt.

ROYAL INSTITUTION, at 3.—Recent Advances in the Exploration of the Atmosphere. Dr W N Shaw, F.R.S.

SOCIETY OF ARTS, at 4 30.—The Bhils of Western India: Captain E. Barnes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Investigations on Light Standards and the Present Condition of the High Voltage Glow Lamp C C Paterson

FRIDAY, JANUARY 25.

ROYAL INSTITUTION, at 9

PHYSICAL SOCIETY, at 5 —The Strength and Behaviour of Brittle Materials under Combined Stress W A Scoble.—A Spectrophotometer F Twyman —Photographs of Electric Sparks K J. Tarrant

INSTITUTION OF CIVIL ENGINEERS, at 8 —Alternating-Current Commutator Motors C A. Ablett.

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THURSDAY, JANUARY 24, 1907

SCIENCE AND TECHNOLOGY OF PAPER.

Paper Technology. An Elementary Manual on the Manufacture, Physical Qualities, and Chemical Constituents of Paper and of Paper-making Fibres By R. W Sindall Pp. xv+253 (London Chas Griffin and Co, Ltd, 1906) Price 12s 6d. net

IN the author's preface it is stated that this work took shape in a course of lectures delivered at Exeter Hall in 1904-6 There is a suggestion here that "Exeter Hall" has extended its "mission" sphere to the paper-maker, but the impression is only momentary

As a matter of fact, the treatise is designed more expressly for the other side of the paper industry, the buyers and consumers, that is, it deals with paper from the point of view of the stationers, printers, bookbinders, and publishers; moreover, the treatment is severely material, strictly limited to "things" and to the exposition of their relations in accordance with the title and subtitle

The first page reveals the author's purpose and method, which are entirely practical There may be some who would question the "practical" qualifications of a technologist who gives prominence to the "ideal paper," which subject is treated in chapter 1 as a *résumé* of the discussion of the important section on chemical and physical constants.

We may clear away an ambiguity associated with this well-known adjective in relation to our subject The "practical paper-maker," as ordinarily so defined, limits his conduct and control of the processes which he superintends to sense impressions—what he can see—the appearance of the "stuff" in the beater or on the machine wire, what he can feel—the "handle" of the stuff in the beater or of the finished sheet, what he can hear—the hum of the beater roll as the measure of the distance from the bed-plate, and the beating work of his machine, what he can smell and taste are also taken as evidences of states and conditions of his material in process

The "practical" buyer judges a paper by the eye, the hand, the tongue—an excellent provider of a slightly alkaline fluid for testing "sizing" efficiency—the ear for "rattle"—and he avails himself also of the sixth sense, muscular sense, in measuring the mechanical properties of resistance to pulling or tearing strains

The technologist, on the other hand, sets out from the position that the actual phenomena which condition the qualities of the finished paper are mainly the invisible and intangible; they are molecular, and belong to the invisible region of the scientific imagination, and can, therefore, only be followed by the methods of science

If we substitute for "practical" the word *thorough*, the technologist may leave the empiric invested with his lesser qualifications, and appropriate the higher designation commensurate with his comprehensive survey of fundamental principles

The author's present contribution to the technical literature of paper-making is entirely in this spirit The second chapter, on "technical difficulties," enforces the useful moral of the relation of difficulty and the critical investigation of defects to progress The examples are well chosen, and it is easy to see that they represent actual working experiences

Following these preliminary chapters we have a brief account in successive chapters of paper-making processes, classified in the accepted order, rag papers, esparto and straw, wood pulp, and the miscellaneous group of packing papers and boards A feature of these chapters is the generalised summary of technical effects given in tabular form Thus on pp 48-9 is a tabulated outline of the processes involved in the preparation of half-stuff of the six leading types and grades, Table vi, p 51, is a comparison of times of beating in relation to half stuff and to quality of finished paper

Table ix, p 77, is a fitting conclusion to the section on wood pulp, giving the details of consumption of fibrous materials, fuel and water for providing the paper for a daily journal with a circulation of 200,000

It may be noted that one average conifer furnishes the pulp for 1000 copies of the average "daily," and the coal consumed is equal to the weight of the paper produced, and may, by the way, be taken to represent many times this weight of the products of antecedent forest growth Such tables occur throughout the book, and give an original impress to matter which otherwise treated would have the unrelieved character of "stock" information

The section on "art" papers is an original discussion of their qualities and *defects*, with indications of the lines of investigation along which progress may be made, to the much desired ideal printing surface, which shall not involve the sacrifice of those qualities in the body-paper conditioning permanence Our "art" papers are an interesting study in compromise, and our "imitation art" papers are still more interestingly artful The author treats them with respectful impatience

Upon this necessary groundwork the manual proceeds to develop the subject of physical, mechanical and chemical qualities and properties of papers, the methods of investigation adopted by the "expert," the numerical expression of the results, with a critical discussion of the value of the constants arrived at In this section the author devotes a chapter to a further *exposé* of the "C B S units," in which special attention is paid to the volume-composition of papers and to breaking strains reduced to the actual unit of sectional area of the paper These units have proved of value in practice, and their usefulness must be insisted upon, especially in educating the young technologist to associate with his tests mental pictures conformable with the actualities of paper In these respects the otherwise comprehensive unit of the "breaking length" adopted by the German pioneers in this branch of technology has been found wanting

In those sections devoted to paper testing, which make up more than half the volume, the author takes pains to make his exposition lucid. We note an occasional slip, as in dealing with the question of a coloured ash left on burning a paper "If blue, ultramarine, Prussian blue, or smalts may be present" This must be corrected as regards the cyanide blue Again —"the blue is tested by boiling with caustic soda and filtering" "The Prussian blue passes into solution" This inaccuracy will be evident to the chemist

In the section on the estimation of moisture we find the expression "bone dry" for "oven dried" Bones are not dry to the chemist, only to the poet

In the "dictionary of chemical terms" and the "glossary of various papers" which make up the concluding chapters we also note a number of slips, which perhaps may be explained by the laudable aim at short, crisp definitions, but this hardly excuses the description of caustic soda as "prepared by boiling carbonate of soda with quicklime", bleaching powder as a "dry *pulverulent powder* prepared by exposing dry powdered quicklime to chlorine gas"—the italics here are our "note of exclamation"; "dextrine" as industrially obtained "by the action of boiling dilute sulphuric acid on starch", "dicotyledon" as including the Coniferæ with angiosperms, such as beech and ash

These descriptive terminologies are excellent in plan, and generally useful They should be carefully revised, and perhaps amplified, in future editions. A section on bibliography would be a useful addition, and we think it is due from the author to acknowledge more fully the sources of much of the matter in this book, especially the German text-books and publications of which he fully avails himself The book is fully illustrated, and the matter thereby pointed and elucidated

It is evident that the work is one we can appreciatively commend to the very wide circle of those interested in "paper", as for the paper-makers, the author only indulges, with becoming modesty, the "hope that this book may prove useful to them" We think they will see the value of keeping pace with the critical knowledge of the consumers

WEIGHTS AND MEASURES

Outlines of the Evolution of Weights and Measures and the Metric System By Dr William Hallock and Herbert T Wade Pp xi+304 (New York The Macmillan Company, London Macmillan and Co, Ltd, 1906) Price 10s net

THE literature of weights and measures is very extensive, and, as a rule, singularly uninteresting Messrs Hallock and Wade are therefore to be congratulated on having produced a treatise on the subject which is at once instructing and attractive For this is an admirable piece of work, in which the result of much tedious research is presented in a bright and lucid narrative The first chapter is devoted to a brief review of the speculations of metrologists and antiquaries concerning the weights and measures of the ancients. It includes a particularly good account of the Babylonian units and the various theories respecting them which have been deduced from the Senkereh tablet and the scale of Gudea. After a rapid survey of the weights and measures of the Hebrews, the Greeks and the Romans, the authors pass on to consider the systems in vogue in Great Britain and in France from the earliest times up to the end of the eighteenth century. The next two chapters and the fifth deal with the origin and extension of the metric system. They trace the system from its embryonic stage in the writings of Mouton, Picard, Huygens, and Cassini, to its fully-elaborated form in the law of April 7, 1795. The geodetic work of Delambre and Méchain is next described, and the opportunity is taken to introduce short explanations of a trigonometrical survey and of the determination of latitude An account follows of the construction of the metric standards of the French Archives and of the lengthy interregnum of *mesures usuelles*

The meeting of the International Geodetic Association at Berlin in 1867 marks an important epoch in the history of the metric system The authors describe the influential part played by it in securing the establishment of the International Metric Commission. This leads to an interesting account of the International Committee of Weights and Measures and its bureau at Sèvres In this connection it may be mentioned that, owing to the death of the British representative early last year, this country is at present not represented on the International Committee The power of appointing a member to fill the vacancy rests with the committee itself In 1884 the committee had some difficulty in finding a suitable representative for this country owing to the fact that the officer in charge of our Standards Department at that time, although an official of standing, was comparatively unknown in the scientific world At the present time, now that all the metric prototypes have been distributed, and thus the most important object of the convention achieved, it is absolutely necessary in order that the United Kingdom may continue to derive any advantage from its contributions to the funds of the Metric Bureau, that the representative of this country on the committee should be an official of the Government department which is charged with the construction and preservation of the Imperial and metric standards It will accordingly, no doubt, be a matter of considerable satisfaction to the International Committee that the recently appointed Deputy Warden of the Standards is an eminent man of science, in every respect worthy of membership in that distinguished body which has included on its roll such names as Mendeléeff, Bertrand, Foerster, Mascart, Christie, and Michelson

In their fourth chapter Messrs Hallock and Wade have set themselves the congenial task of explaining the standards of weight and measure in vogue in their own country The desirability of a simple and uniform system of weights and measures [illegible]fully

realised at an early stage of the existence of the United States. Washington devoted much attention to this subject; and it was under his direction that in 1791 a committee of the Senate entered upon a very full consideration of the questions involved They reported in favour of a decimal system, and recommended the adoption of a standard of length divided into five equal parts, each of which would correspond to a foot. No legislative action was taken, however, to give effect to these recommendations In 1819 a committee of the House of Representatives submitted a report advocating that models of the yard, bushel, and pound, conforming to those in most common use, should be made and adopted as the standard weights and measures of the United States This proposal also proved abortive The elaborate report prepared in 1821 by Mr Secretary (afterwards President) Adams, a warm admirer of the metric system, was likewise without any immediate effect The metric system was not seriously considered in the United States until 1866, when the use of the system was authorised by Congress In 1889 copies of the international metric standards were distributed by the International Committee to the various States which were parties to the Metric Convention The copies received by the United States were immediately adopted as primary standards, and in 1893 a formal order of the Treasury Department recognised the international prototype metre and kilogram as fundamental standards, and directed that the customary units, the yard, and pound were to be derived therefrom

Chapters vi, vii, and viii deal with the advantages which would be derived from the universal employment of the metric system in commerce, manufactures, and medicine The authors admit having a bias in favour of this system, and they make out a very good case for its general adoption In the next chapter international electrical units are considered, and attention is directed to the benefits conferred upon electrical science by the introduction of the C G S system at the instance of the British Association The United States specifications for the practical application of the definitions of the ampere and volt were prepared by the National Academy of Science in 1895, in compliance with the provisions of an Act of Congress These specifications, which are quoted *in extenso* on pp. 211–215, differ in some slight respects from those prepared in this country about the same time by the Board of Trade

A most instructive chapter is the tenth, which relates to the construction and comparison of standards The various physical properties which should be possessed by primary standards are discussed, and an account is given of the different alloys which have been used in the construction of such standards The relative merits of line and end standards are next considered, the method of subdividing a scale by means of a dividing engine being well described It is mentioned that at the International Bureau the graduation of a metre into millimetres in this way occupies about sixteen hours The footnote on p 226 quoted from Guillaume appears to contradict the statement in the text respecting the accuracy attainable by this method.

A very good description is given of the comparators employed in the verification of standards of length, and the mode of using them is explained After some account of balances of precision, the British imperial standards of length and weight are described with illustrations The name of Mr Chaney, the late superintendent of weights and measures, is misspelt on p 247, and the position which he occupied is inaccurately designated as Warden of the Standards The latter office has been since 1878 an honorary adjunct to the permanent secretaryship of the Board of Trade

The chapter concludes with a simple and interesting explanation of measurement by means of wave-lengths of light This method was originally only applicable to the measurement of very short intervals, but Michelson has extended its application to lengths of any magnitude It is of great interest in metrology, since by making re-determinations from time to time positive testimony may be obtained as to whether any variation is taking place in the length of a standard At the present day the permanency of bronze standards of length is regarded with suspicion by metrologists The authors refer on p 219 to the fact that many of the bronze copies of the British yard which were distributed to various nations and scientific institutions in 1855 are believed to have since undergone changes in length due to molecular rearrangement This casts some doubt upon the invariability of the Imperial Standard Yard, which is made of the same material The recent developments of Michelson's method afford a ready means of deciding this important question

Some useful tables are appended, and a comprehensive index brings this well-conceived work to a close

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ITALIAN SCIENTIFIC WORKS

I grandi Trafori Alpini By G B Biadego Vol i Pp xvi+1228, in addition to about 36 folded pages of tabular matter Vol ii 30 large folded plates (Milan Ulrico Hoepli) Price 45 lire (1l 16s)

Opere matematiche di Francesco Brioschi Vol iv Pp ix+418 (Milan Ulrico Hoepli, 1906) Price 1l

I Motori a Gas By Vittorio Calzavara Pp xxx+424 Manueli Hoepli (Milan Ulrico Hoepli, 1906) Price 4 50 lire

I Motori ad Esplosione, a Gas luce e Gas povero By Ing Fosco Laurenti Pp xii+361 Manueli Hoepli (Milan Ulrico Hoepli, 1906) Price 4 50 lire

THE opening of the Simplon tunnel amid a flourish of Italian trumpets was a fitting opportunity for the publication of a book dealing with this and other mountain borings That the author might have written a book on the Simplon tunnel alone is evidenced by the fact that the part he devotes to this tunnel occupies the space of an average-size volume

But he wisely points out that the Simplon is only one of a series of enterprises of the same kind, and while there have been improvements in the methods of working, as well as in the use of better explosives, the merit of originality belongs more properly to what is commonly known as the Mont Cenis tunnel Tourists to whom the name *Fréjus* represents a town on the Riviera will be somewhat surprised to find this tunnel described as the Galleria del Fréjus, which appears to be its correct name. In addition to this, the St Gothard, the Arlberg, and other well-known tunnels, the author describes several minor borings not commonly noticed by tourists, but which possess points of special interest; for example, one at Laveno, on Lago Maggiore The result is a volume of 1228 pages (excluding tables), and a second volume of plates, which form a striking contrast to the small Manueli Hoepli of the same publisher When we come to eighty pages of "Final Considerations," we cannot help being reminded of the typical interminable sermon of our early days, and the analogy is further increased by finding 115 pages of "appendix to the final considerations" to follow But all the same, the author cannot be accused of long-windedness There are a great many details connected with the boring of a tunnel, such as the rate of progress through different rocks, temperature conditions, descriptions of the machinery and of the accommodation for the workpeople, which interest not only the engineer, but also the general reader, and it cannot be said that the author has encumbered his subject with unimportant or uninteresting details to any appreciable extent The only exception we notice is that the tables of mean temperatures of such places as Venice, Alassio, and San Remo do not appear to have much bearing on the Simplon tunnel, under which heading they are tabulated The text would have been handier had it been bound in two volumes

From the same publisher we have the fourth volume of Brioschi's works, comprising mainly papers contributed to the Lincei Academy (1885–1896), the *Comptes rendus* (1858–1878), and miscellaneous journals, together with the preface and notes written for the Italian translation of Cayley's "Elliptic Functions" The papers for this volume have all been edited by Profs Francesco Gerbaldi and Ernest Pascal, and the volume is uniform in style with its predecessors In view of the rapid growth of mathematical literature, one cannot help wondering, however, if it is desirable to publish collected works in such an irreproachable style This reflection is suggested partly by the fact that though one or two English transactions have recently appeared with larger pages than formerly, they do not contain a corresponding increase in the number of words per page, though there is a great increase in their *weight* And it should be the object of the purchaser to obtain Brioschi's works, not merely to buy good paper and printing

The series of Manueli Hoepli, published in the form of pocket-books, numbered 900 volumes in April last Among the latest ones dealing with technical applications of science we have before us two books on gas engines, both written by authors living in Venice, and containing respectively 160 and 164 woodcuts. The objects of the books, as stated in the prefaces, are nearly identical Both authors point out that while other countries have advanced greatly in the study and construction of gas engines, the subject has received little attention in Italy Curiously enough, Signor Calzavara, who is a gas engineer, says less about the question of gas than Signor Laurenti The latter's book is divided into three parts, the first dealing with the combustibles (illuminating gas and heating gas, or "gas povero," as it is called in Italy), the second with gas generators, and the third with the gas engines themselves On the other hand, Signor Calzavara only devotes a single chapter to the gas question This chapter is, however, a long one, and it must be remembered that he has written several previous books on gas and gas motors

Other differences may be noted Thus Signor Calzavara gives a really full bibliography, while Signor Laurenti's book contains more numerical data in the form of tables Signor Laurenti goes into detail regarding cams, the other author only just refers to distributors without discussing the cam. Signor Calzavara considers that a "poor gas" engine, with its own generator, cannot be used efficiently for installations of less than 25 horse-power, Signor Laurenti fixes the limit at 15 horse-power These are the differences one would expect to find in two books written on the same subject by different authors, and they show that anyone interested in the subject would derive undoubted advantages from having both books for reference G H B

THE ATOMIC THEORY OF ELECTRICITY

The Electron Theory, a Popular Introduction to the New Theory of Electricity and Magnetism By E E Fournier d'Albe Pp. xxiii+311 (London Longmans, Green and Co, 1906) Price 5s. net

A GLANCE at the table of contents of this book is sufficient to show that it fills an acute want at the present time It attempts the consistent application of the all-embracing electron theory in an elementary manner to the whole range of electromagnetic phenomena In making this attempt, the author is to be congratulated both on the choice of his subject and the skill and originality he has displayed in accomplishing it It is a relief to find that the treatment, though popular, is to the point, and little or nothing is said of those vague and vast speculations as to the ultimate constitution of matter which have unfortunately become identified with the words "the electronic theory"

Few possess the necessary qualifications for a task which covers such a wide range of subjects, and, so far as we know, this is the first time it has been seriously attempted The book is therefore unique, and should prove of value to the student, the teacher, and the investigator. Although, no doubt, it would be possible to go through the work pointing out where a fuller treatment of the subject-matter would have been advantageous, this would hardly be fair in the present state of the science. We have rather to be grateful that a trustworthy guide,

to the theory in its existing state, has pointed the way to its wide application in a great many cases. As the author repeatedly points out, the logical consequences of the electronic theory are still very far from being worked out in many of the subjects dealt with, and this task offers a fine field of investigation, which may ultimately lead to new results of the highest practical importance

Probably nowhere is this more true than in the field of electrochemistry, of which, however, the treatment is somewhat superficial and unsatisfying Another topic, which fares even worse, and yet is one of which much might have been, and ultimately will be, made, is the optical activity of carbon compounds What little is said is so misleading, for example the last sentence of chapter xii, that it should be either omitted altogether or considerably amplified In the main, however, the treatment is refreshingly clear and interesting

Of course, it is to the explanation of that class of phenomena known as electromagnetic that the electron theory offers the greatest simplification Consider a phenomenon such as "the spark on break due to the extra E M F of self-induction," which is nothing but the electrical analogy of the water-hammer in a pipe when a cock is suddenly closed and the water stream stopped For water read electrons, and for pipe read conductor, and even a beginner gets a clear mental picture of the phenomena That all magnetic and electric phenomena are to be explained by definite motions and properties of the individual electron is a simplification that may be expected to ameliorate the lot of the future student considerably The electron theory provides for electricity that clear mental image of the processes involved, without which physical theories stagnate and become metaphysical Nevertheless, the faculty of being able to think in more than one system is not easily acquired, and it is doubtful, for example in magnetism, if anyone trained on the present systems will ever really abandon them

In addition to the topics already alluded to, chapters are devoted to the electronic treatment of thermo-electricity, the Hall and allied effects, optical phenomena, the Zeeman effect, radiation, voltaic electricity, radio-activity, and the electric discharge One chapter is devoted to a speculative effort, bold and imaginative, but logical, well considered, and unexceptionable, on the similarity of the infinitely great phenomena of the cosmos with the infinitely small of the electronic universe Finally, a new system of electrical quantities is advocated, in which electricity, represented by E, ranks as a fundamental quantity with length, mass, and time The author uses throughout the expressions "company of electrons," "army of electrons," to represent respectively the E S unit (2930 million) and the coulomb (8 79 trillions), and thus once for all reduces electric quantities to a definite *number* of electrons

Different readers will no doubt derive most benefit from different chapters according to their individual knowledge of the subjects referred to, but the book may be recommended to all interested in the progress of physical science Dr G. Johnstone Stoney, whose portrait appears as a frontispiece, contributes a preface to the work. F S

OUR BOOK SHELF

Manual of the New Zealand Flora By T F. Cheeseman Pp xxxvi+1199 Published under the authority of the New Zealand Government (Wellington J Mackay, 1906)

THE number of botanists who have contributed towards a knowledge of the New Zealand flora during the last forty years is remarkable, especially when it is recognised that their labours followed on discoveries made by earlier explorers and collectors of eminent repute Banks and Solander, Colenso, Sinclair, and Hooker are a few of the early botanists whose work was collated in the "Handbook of the New Zealand Flora," compiled by Sir Joseph Hooker and published in 1864 Since that date, besides Colenso, Thomas Kirk stands out prominently as an energetic collector and author, he collected not only throughout both the main islands, but also visited several of the adjacent groups Owing to his extensive acquaintance with the subject, in 1894 he was commissioned by the Government to prepare a flora of New Zealand, but the work was only half completed at the time of his death three years later The task was subsequently entrusted in 1901 to Mr Cheeseman, who has contributed numerous papers on new species, on the floras of Three Kings and Kermadec Islands, and on special methods of fertilisation in various genera The wisdom of the choice is seen in the exhaustive and careful compilation now published

The arrangement follows the plan of Hooker's earlier work, and to students of British botany acquainted with Bentham's "British Flora" this manual presents a familiar disposition

Turning to the subject-matter, as the result of the last forty years' work the computation of ferns and flowering plants has risen from about one thousand to nearly sixteen hundred species—exclusive of those naturalised—spread over 382 genera With regard to orders the predominance of Compositæ is natural, but the flora is unusually rich in ferns and species of Scrophulariaceæ, and poor in species of Leguminosæ The number of species in some of the genera is very large, amounting to forty-three in Celmisia, of which all are endemic with one exception, Veronica shows eighty-four species, of which, in contrast to our conception of the genus, seventy-one form shrubs or small trees The flora contains many curious plants and unique associations that have been graphically described by Dr L Cockayne, but from a systematic point of view the most extraordinary fact is found in the enormous proportion of endemic species, amounting to nearly three-quarters of the total

In working through a flora of such vast dimensions and containing so many exclusive species it will be comprehended that Mr Cheeseman has accomplished a task of no small magnitude, and from the critical notes accompanying the technical diagnoses an idea is obtained of the wide knowledge and judicious discrimination that he has brought to bear upon it The author and the New Zealand Government are both to be congratulated on the successful completion of the work

Evidence of incorporation of the latest discoveries is found in the new genus Townsonia and various new species The author has provided in the appendices a

synopsis of orders arranged according to Engler's syllabus, a summary of naturalised plants, and a list of native names

Side-Lights on Astronomy and Kindred Fields of Popular Science Essays and Addresses. By Prof Simon Newcomb Pp vii+350 (London and New York Harper and Brothers, 1906) Price 7s. 6d net

IN bringing up to date and publishing in book form this collection of essays, which have from time to time appeared in various American journals, Prof Newcomb has provided us with a volume which is at once interesting and instructive The range of subjects is a wide one, extending from a discussion of the question, "Can We Make It Rain?" to the flying machine and the structure and extent of the universe

The chapter on the making and using of a telescope should prove interesting to anyone who uses this instrument, whilst "The Fairyland of Geometry" will provide food for thought for many hours to those amateur astronomers whose acquaintance with the science has been restricted to observation only

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications*]

Radium and Geology

IN considering the influence of radium on earth history, it appears to be generally assumed that the radium detected everywhere in the surface materials of the earth is an original constituent of the igneous rocks An entirely different view has been lately pressing itself upon me I put the view forward mainly because I think there are difficulties in the way of accepting the original or primary nature of the radium in rocks These objections I first briefly state

The original nature of the radium cannot be maintained without at the same time assuming the presence of the associated uranium to make good the radio-active decay Now it is easy to show that if such uranium existed grave difficulties arise from the facts of solvent denudation The ocean which receives the dissolved rock materials must be in an entirely different state from what is observed Even assuming geological time as only a very few million years, the quantity of radium now in the ocean should be much greater than has been observed If the river supply of dissolved rock materials had been sustained for only some 20×10^6 years, the sea-salt should possess a richness twenty-five times as great as the ascertained amount

In stating this I make the assumptions—which I think, however are not easily evaded—that radio-active substances are removed from the land along with other mineral matter, and that, along with radium brought into river water on the break-up of rock minerals, the postulated uranium is also carried to the ocean On these assumptions we can arrive at an approximate estimate of what should be the existing state of the ocean on any possible estimate of geological time

We do not require accurate figures We are only really concerned with their order of magnitude I take, in the first place, the Hon R J Strutt's estimate of the radium in sea-salt, stated to be approximate only The quantity is $0\cdot15\times10^{-12}$ grams per gram From this there must be in the ocean about 8×10^9 grams I assume the oceanic mass as $1\cdot468\times10^{24}$ grams On Dr Boltwood's result for the value of λ(year)$^{-1}$ for radium, to maintain this quantity there must in some way be brought into the ocean $1\cdot78\times10^6$ grams of radium per annum

I now turn to the approximate river supply We have Sir John Murray's estimate of the total volume of river water and the dissolved matter therein, which annually enter the ocean. The dissolved matter amounts to $5\cdot1\times10^{15}$ grams. If we suppose the matter in solution still to possess the mean radium content of the igneous rocks as determined by the Hon R. J Strutt, that is, 5×10^{-12} grams per c.c. (and the application of this number can be justified on data at our disposal), we find that 10^4 grams of radium enter the ocean annually from the waste of the land It will be seen, in the first place, that this quantity, unless the uranium enters along with it, is not nearly what is required to maintain the oceanic radium at its approximate present value, but if, on the other hand, the associated uranium enters along with the radium, in 8×10^5 years there would be such an accumulation of uranium in the ocean as to account for the existing amount of radium. But we have not to deal with 800,000 years. If geological time was but a few million years, and solvent denudation had progressed as here assumed, the facts as regards oceanic radium would be entirely different from the observed facts, even allowing a wide margin of error in all the data involved In 100×10^6 years there should be $0\cdot19\times10^{-12}$ grams of radium per gram of sea-salt. I neglect the rate of decay of uranium, as this rate involves periods of the order of thousands of millions of years.

Is there any way of evading this difficulty? If we assume the uranium to be in some way caught in the sediments, and so brought again into dry land, we must expect to find a concentration to occur in them; but the facts are the other way The average radium content of the sediments appears to be less than half (2×10^{-12}) that of the parent igneous rocks, and is, in the case of the detrital sediments and on the assumption of the original nature of the radium, presumably what remains behind with the less soluble constituents of the parent rocks Nor can we suppose the uranium retained in the soils, for then we must face a still more extraordinary concentration of radium, whereas the soils are apparently poor in radium If it is supposed to be concentrated in the rocks beneath the soils, difficulties have to be faced with other heavy metals And in this case, of course, examination of the surface rocks tells us little as to the radium-content of the deeper lying rocks, save that these should contain much less We are observing, in fact, the concentration products of about a mile and a half deep of parent rock removed by the wear and tear of geological time, and know not the depth to which these products extend But such a continued accumulation on the land is hard to comprehend It appears to me that the simplest conclusion is that there is no associated uranium generally distributed throughout the surface materials of the earth I of course do not refer to the ore bodies, thermal springs, &c Again, in certain igneous masses uranium undoubtedly exists occluded in the minerals, whatever history we may ascribe to it

But if there is no associated uranium, whence comes the radium everywhere distributed over the surface of the earth? It cannot be from volcanic sources These are entirely too local in their influence Nor yet can we suppose it to reach the surface, as ores in general do, by means of fissure veins, &c These, again, are quite local in their influence Indeed, the Hon R J. Strutt points to examples of this in the case of the uranium deposits, the adjacent igneous rocks were not abnormal in their radium content

By a process of exclusion, if for no other reason, we are, I think, justified in considering the possibility that the radium is picked up by the earth in its motion through space The probable source would be the sun There are, in point of fact, many arguments in support of this view besides that by exclusion The fairly uniform distribution over the earth's surface at once finds explanation, The picked-up radium probably floats in the atmosphere for a long time, and ultimately is helped downwards to the surface by rain and snow, and other meteorological conditions Once upon the surface of the land, percolating waters will carry it to all depths to which such waters penetrate, It has many thousands of years for its travels

before its radio-activity dies out We would expect that the more impervious mineral substances would show the least amount. Quartz is without radium, as the Hon. R. J. Strutt shows by his determinations

There appears to be no improbability that matter in minute quantities might reach us from the sun Here we are observing the most minute traces If the observations are correct as to the velocities of solar ejections, it would take but a few days to bring solar matter into the orbit of the earth The sun-spot-weather connection may possibly be involved, as well as the phenomena of atmospheric radio-activity, although doubtless emanation from radium already accumulated on the surface and in the soils is mainly responsible for these latter effects Whatever may be said as to the value of such subsidiary evidence, it appears as if only by looking to such an extra-terrestrial origin of radium can we evade the difficulties connected with the associated uranium We are evidently not compelled to assume that the radium received upon the earth carries with it the equilibrium amount of uranium, although doubtless we may expect that some uranium is also received.

It is possible to arrive at a rough estimate of the amount of radium reaching the earth if we assume the annual oceanic supply of radium is mainly extra-terrestrial, and that a state of radio-active equilibrium with the average rate of supply has been attained In effecting this estimate we deduct the annual river supply from the supply required for maintenance of the radium concentration of the ocean The result is an annual supply to the ocean of 1.77×10^{4} grams If this supply is received uniformly over the oceanic area, about 12.5 milligrams enter over each square mile per annum This result is probably excessive, as it assumes no uranium to be in the ocean or received from extra-terrestrial source

If it is permissible to apply to the land area the mean figure deduced for the ocean, we can ascertain the depth to which the observed radium content of the sedimentary rocks would be maintained at its present value It is but trifling—about ten metres As I have indicated above, however, the received radium will be washed from the surface soils and carried into the denser and more retentive rocks The due proportion is doubtless carried to the sea on the break-up of the rocks or by percolating waters We are no longer in difficulties on this score J JOLY

Trinity College, Dublin, January 6

P S—A small quantity of radium will almost certainly be carried to the land along with wind-borne sea-salts * From Pierre's measurements of the latter on a coastal rainfall of 60 cm, I find that about three thousandths of a milligram per square mile (1.2×10^{-15} grams per sq cm) per annum will in this way reach coastal countries This small quantity will not complicate the problem unless there is associated uranium, and unless, further, this latter substance accumulates in the rocks In this case the rocks of coastal countries might in course of time come to have a higher content of radium than interior continental rocks But, I repeat, the supposition that uranium will continually gather in the rocks and never follow the usual channels of escape seems very improbable

Much remains for investigation, naturally arising out of Mr Strutt's fertile work Rain-water should be systematically examined, due allowance being made for wind-borne radium carried from the sea. I have begun such observations, but they will necessarily demand time and care if they are to be of value In the hope of getting further light on some of the points at issue, I have the rocks of the Simplon Tunnel and certain of the deep-sea oozes under examination J JOLY.

January 16

Green Sunset Colours.

THE green sky described by Mr Collins in NATURE of January 3 (p 224) was evidently an unusually brilliant example of the green tints often seen in a sunset sky As I have not seen any explanation of the phenomenon, it may possibly be of some interest to give the following attempt at one

The colour of the sky at any time is made up of two components A, the light from the upper regions, B, that reflected from the small particles in the lower air The A component is always blue, and its spectrum shows a deficiency in red and yellow rays Its light passes between the particles, and therefore forms a background upon which they are projected The spectrum of the B component is variable When the sun is well above the horizon the light is white, and the variations in the deepness of the blue of a clear sky are due to differences in the relative proportions of A and B As the sun nears the horizon the B light begins to lose its more refrangible rays, and the absorption extends towards the green and yellow as the sun goes down

Now if we take two equally brilliant spectra, cut out the red, orange, and yellow from one, and the violet and blue from the other, and then mix the residues, we shall obviously have all the colours necessary to make white light with a double allowance of green An eye receiving the whole will see pale green This, I take it, is the origin of the green colours of the sky The A component is deficient in the less refrangible rays, which are supplied by the B component, and the two spectra overlap in the green, showing an excess of that colour

Occasionally, but rarely, the two are exactly complementary over a limited stretch of sky, and then white patches are seen amid the colours of the sunset which are easily distinguished from clouds They shade off on one side into tints of green where the spectra overlap, into yellow where the B component is in excess, and into blue where the A light preponderates

When the sky is clear it is no uncommon thing to see a considerable expanse of green, shading on the one side into pale lemon-yellow where the overlap of the spectra is considerable, while on the other side it shades through a narrow border of silvery tint where the balance is exact into a delicate rosy hue where there is a general deficiency in the central rays

Green tints are by no means always to be seen and I think the foregoing explanation shows why—their production depends upon such an adjustment between the brightness of the two components that they shall be approximately equal The white patches are rarer still, as they require exact equality in brightness and correct apportionment of colour ARTHUR W CLAYDEN

5 The Crescent, Exeter

Ultra violet Fluorescence of Benzene

FROM my observations on the emission of light by canal rays (*Ann d Phys*, 21, 401, 1906, *Physik Zeitschr*, 7, 355, 1906), I have concluded that absorption of light in a band spectrum (running towards the red) produces fluorescence Hartley and others have stated that benzene has a banded absorption spectrum in the ultra-violet, adopting that principle, I conjectured that benzene had an ultra-violet fluorescence I have confirmed this by the following method —The ultra-violet rays from a mercury lamp by W C Heraeus (Hanau, Germany) fell vertically upon a diluted solution (0.25 per cent) of benzene in alcohol, and the fluorescence light emitted by it horizontally was analysed by a quartz spectrograph In the spectrograms obtained there appeared, besides the mercury lines, a group of four strong continuous bands situated in the ultra-violet between $\lambda\lambda$ 271 and 314 $\mu\mu$, these bands run towards the red end of the spectrum, and the heads have the wave-lengths 272, 280, 283, 292 $\mu\mu$

As Hartley has shown, the absorption spectra of the benzene derivatives are produced by an alteration (both in intensity and spectral position) of the simple benzene spectrum, such an alteration is produced by condensation and substitution According to our principle, the same is true for the fluorescence spectra of the benzene derivatives. The question as to the relations between chemical constitution and fluorescence is thus reduced to the question of the relations between chemical constitution and absorption, and banded absorption must be explained with regard to the fact that it is coupled with fluorescence There may also be drawn from the above result some conclusions about the constitution of the benzene ring

J STARK

THE KINGSTON EARTHQUAKE

WHEN Port Royal was destroyed by the great earthquake of 1692, some of the surviving inhabitants took refuge on ships, others moved across the haven to a place called Kingstown or Killscown, where, in huts made of boughs, exposed to the heavy rains and in close proximity to hundreds of dead bodies in the bay, they "died miserably in heaps." Port Royal was rebuilt and maintained as a naval station; its successor, as a place of business, was founded the following year at Kingston, and by the earthquake of January 18 has now met with a similar, though fortunately less complete, destruction.

The two earthquakes differed considerably in intensity. In 1692 the whole island suffered. Scarcely a house in any part of it was left standing. By numerous land-slips, the mountains were stripped of vegetation and altered in form. The earthquake of that year was one of the first order of magnitude. The most remarkable fact about the recent shock is the very limited area of damage. Kingston seems to have suffered most severely. The more important buildings are ruined, and few, if any, houses have escaped some injury. Port Royal, six miles to the south, and St. Andrew, within five miles to the north, have shared to a great extent in the ruin, but outside a radius of ten or twelve miles from Kingston the loss to property is small. Some houses in Spanish Town, eleven miles to the west, are said to be damaged, while Port Antonio twenty-eight miles to the north-east, and Holland Bay, thirty-eight miles to the east, are almost unharmed.

From the small area of excessive damage and from the rapid decline in the intensity of the shock, it may be inferred that the focus was situated close to Kingston and at no great depth below the surface. Partly to the proximity of the focus, partly also to the sandy or gravelly nature of the ground (for earthquakes are always more strongly felt on loose, friable beds than on hard, compact rock), we must attribute the destructive energy of the shock. That, in its initial power, the earthquake was inferior to those of Valparaiso and San Francisco is clear from the smallness of the meizoseismal area, and also from the comparatively slight disturbances recorded at the observatories of Washington, Shide, and Edinburgh.

The onset of the shock was sudden, there being no warning tremors or sound. For thirty-six seconds the motion was like that felt on a ship in a choppy sea. All observers agree that the movement was chiefly vertical. It is said that objects jumped from the ground, and this, if it be true, shows how violent was the shock and how close was Kingston to the focus. In many places the ground is fissured, the electric-tram rails are twisted, and the water supply pipes are partially damaged—all indications of a neighbouring focus. The direct line of cable to Colon is broken about three miles from the shore, pointing either to a displacement of the ocean-bed or to a submarine land-slide—probably to the latter, for there were no marked seismic sea-waves on the south side of the island,[1] and the shipping in the roadstead and harbour are unharmed. The subsidence of the battery at Port Royal and the sinking of the shore at Kingston show that the superficial beds, at any rate, have undergone important changes of level.

Whether these changes be due to bodily displacements of the crust, to mere shifting of the surface-beds or to both is by no means clear. When the island was surrendered to English forces in 1655, the spit, called the Palisadoes, which now terminates in Port Royal, was discontinuous, and the end resembled one of the quays or small islands outside the harbour. By 1692 the gap was bridged by a bar of sand. During the earthquake of that year a portion of the spit, a quarter of a mile in length, suddenly subsided, so that only the chimneys or upper parts of houses that were not overthrown appeared above the water. The harbour of Port Royal also sank, so that the streets along the harbour-side afterwards lay at a depth of from four to eight fathoms. Yet the depression of the ground itself at Port Royal and in other places was not supposed to exceed a foot.

There can be no doubt from the evidence above described that the seismic focus was situated, in part at least, almost vertically below the haven between Kingston and Port Royal, though a portion of it may have extended as far as three miles to the south of the coast. It is also probable that the Port Royal and Kingston earthquakes originated roughly within the same focus.

The West Indian region is distinguished by those steep surface-gradients which characterise areas of great instability. Jamaica, in common with Porto Rico and the south of Haiti, lies along a crust-ridge, which towards the west is prolonged into the mountains of Honduras, while it is separated from a corresponding ridge constituting the island of Cuba, by the submarine depression of the Bartlett deeps. To the east, the Jamaican and Cuban arcs unite in one main ridge which bends round to overlap the curved line followed by the volcanic islands of the Lesser Antilles. These form the north and east boundaries of the great deeps of the Caribbean Sea. On the south lie the mountain ranges of Venezuela, &c., which, as we know from the destructive earthquakes of Cumana in 1799 and 1853 and of Caracas in 1812, are still in the stage of vigorous growth. Towards the west, and connected with the West Indian series, are the central American chains, also studded with volcanoes, and in parts frequently visited by violent earthquakes. In this West Indian region as elsewhere, it is not unlikely that the mountain arcs have a tendency to press forward on their outer and convex side, and to subside towards the interior of the arcs. The movements along the line of the Lesser Antilles certainly suggest a slipping westwards into the Caribbean deeps. In Jamaica, along the northern boundary of that sea, the movement may be more complex, the northern side of the Jamaican ridge having a tendency to move northwards and forwards towards the Bartlett deeps, while on the south there is a continued subsidence and slipping towards the Caribbean Sea. Of such intermittent slips, the Port Royal and Kingston earthquakes appear to be some of the latest manifestations.

So far as I am aware, there is no evidence of that intense crushing that was so conspicuous a feature of, say, the Japanese earthquake of 1891. Extension rather than compression was manifested in 1692, for at Port Royal one whole street, in which many houses were left standing, was said to have been doubled in width by the earthquake. There is much evidence to favour such a view in the case of the Kingston earthquake—the extremely local character of the destructive shock, the snapping of the cable to the south, and the minor character of the disturbances registered by distant seismographs.

CHARLES DAVISON.

[1] A so-called "tidal" wave was observed on the north side of the island. It is said that Anotta Bay was inundated and that houses were swept away. No time is mentioned, and if the sea waves were of seismic origin, we should expect to hear of similar reports from Port Antonio and other adjoining harbours.

A PICTURESQUE HISTORY OF DACCA[1]

THIS very interesting and picturesque historical story portrays the dwellers in the land where the two great waterways of eastern India, the Brahmaputra and Ganges, unite before they fall into the Bay of Bengal It tells how they and their forefathers have by their persevering industry, ingenuity, and commercial ability made Dacca and its adjoining predecessors, Rampal and Sonargaon, capitals of a kingdom which, though often disorganised by misgovernment and robbed by its neighbours, the Mughs and Assamese, yet always when allowed to manage its own affairs in peace rose again to be a busy and prosperous manufacturing city

The early history of these successive towns is traceable in the annual popular religious festivals of the country The two chief of these are, first, the Jamastami, held on the 23rd of the lunar month Srabon (July–August), as the birthday of Krishna, tutelary god of the weavers of the incomparably fine muslins which had enriched the merchants of Dacca and its predecessors when weaving was the chief industry, and, secondly, the Nangulbundhi plough (nangul) making festival of Cheit 8 (March–April), of which an illustration is here reproduced Both are admirably described in this book, but it is the last which creates the greatest and most universal popular enthusiasm, as being the birthday of the land and of the plough which tilled the fields of cotton whence the Dacca muslin was woven

The plough-god of the feast is Parasu-Rāma of the two-bladed axe (parasu), whose first birth story was framed in western India by the fire-worshippers who made the household and altar fire their national god In the Mahābhārata he is the great-grandson of Bhrigu, the father of fire, whose son Richika, the fire-spark (richi), begot from the two sacred mother fig-trees the Banyan and Pipal, whence the altar fire was engendered, Jama-d-agni, the twin (jama) fires (agni) His wife was Renuka, the flower-pollen (renu), and their fifth son was Parasu-Rāma He slew his mother with his two-bladed axe, the two lunar crescents of the waxing and waning moon, and this story tells us in symbolical language that he was born as the generating seed to be ploughed into the earth when his flower-mother died In his history, as told in this book (pp 295–8), he fled to the source of the Brahmaputra to obtain pardon of the sin of matricide, and there God changed his axe to a ploughshare, which cleft the mountain and made a way to the sea for the holy river In his western Indian legend he is said to have made the sons of the fig-tree rulers of India by conquering and slaying its Haiheya masters, who survive in eastern India as the Mughs, who gave their name to Maghada, now Behar They were the first settlers in the Gangetic valley, and in the history of Dacca always attacked and robbed its people when they were unable to protect themselves, and their successors, Parasu-Rāma's sons, ploughed the cotton fields which fed the looms of the Dacca weavers Like the Kurmis who first grew cotton in the black soil of western India, they covered the country with water-tanks like those made by the road- and lake-making Sen king Ballal Sen, whose capital, Rampal, took its name from the plough-father Rāma, whose sons peopled the Indian river valleys before the later traders, whose god was Krishna

[1] "The Romance of an Eastern Capital By F B Bradley Birt Pp. x+349. (London Smith, Elder and Co, 1906) Price 12s 6d net

The early history of the union of the farming, pastoral, and artisan founders of the Indian nation is told in the Gond poem the Song of Lingal, the Linga god It says that Lingal united them as subjects of the Tortoise (Kush), which in the primitive national geography supports the earth floating on the ocean The races thus united were the Nāga-Kushikas, who with their successors, the Ikshvāku, sons of the sugar cane (iksha), laid the foundations of Indian society The Nāgas were the Haiheyas, whose empire, when they were conquered by the Mahrattas in 1740 A D, had shrunk to the Nāga countries of Nagpur and Chutia Nagpur in Central India The Kushika were the sons of the Kusha grass sacred to Krishna, the black antelope god and it was with it that in their ritual his national earth altars on which milk libations were poured were thatched, and their Prastara the magic rain-compelling wand borne by the high priest, was made of Kusha grass These altars were by the Ikshvākus, who offered animal sacrifices, thatched with the boughs of a new sacred fig tree, the Plaksha or Pakur (*Ficus infectoria*), and their Prastara was made of Ashvavala (*Saccharum spontaneum*), wild sugar-cane grass The Kushika marriage rite, which united each wedded pair by binding their hands together with Kusha grass, still survives among the Chasas and Koch Rajbunsis, the chief cultivators of Orissa and eastern Bengal, and many other trading castes

Pilgrims bathing in the Sacred River during the Nangul bundhi Festival From 'The Romance of an Eastern Capital

The artisan and trading offspring of these pioneer races ruled Rampal when its kings were, at the close of the age when Buddhism was the prevailing religion of India, the Pals They belonged to the Subarna Banik clan, of which many of the richest merchants and bankers of Dacca are members and which claims descent from the Naga Rishi and

Kashyapa, the Kushika father. Also their successors, the Sen kings, who restored the Hindu ritual and made Sonargaon their capital, are shown by their name to belong to the Subarna Bhanik clan.

The later kings of this dynasty became tributary to the first Mohammedan conquerors under Bukhtiyar Khilji, and were finally dethroned by Tughral Khan and Balin, Emperor of Delhi, and his successor, Alla-uddin, made Sonargaon and its territories the eastern province of Bengal. Its subsequent history tells of the rule of successive viceroys, their rebellions and wars with the Delhi emperor, ending with the conquest of Bengal by the Afghan king Sher Shah and his clan, of whom the last ruler was Isha Khan, the converted Hindu. His marriage with the Hindu Sona Bibi, his successor, and his submission to Man Singh, Akbar's general, whom he had worsted in single combat, furnishes one of the most stirring tales here told. The story then tells of the building of Dacca by Jehangir's viceroy, Islam Khan, in 1608 A.D., and of the generally troublous rule of the viceroys of the Emperors Jehangir, Shah Jehan and Aurungzebe, in whose reign Dacca enjoyed twenty-five years of exceptional prosperity under Shaista Khan, Shah Jehan's first cousin, and uncle by marriage to Aurungzebe, who married Shaista Khan's niece. Under his rule the English came to Dacca, and the story of their early struggles and final conquest of Bengal is most ably told in this book. The introduction of English machine-made cloth and English thread ruined the muslin trade of Dacca, and made it first an indigo mart and afterwards what it now is, the centre of the Bengal jute trade.

J. F. HEWITT.

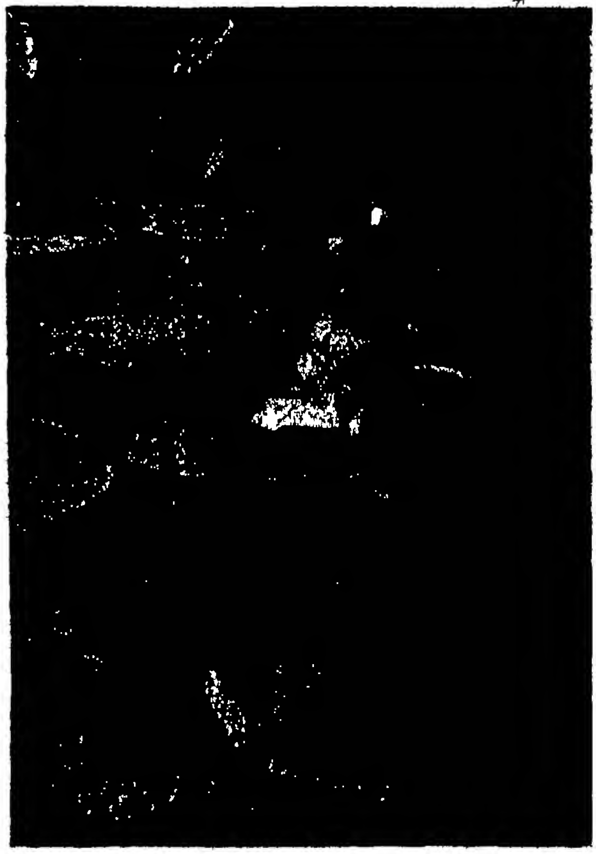
PLANT LIFE.[1]

UNDER the somewhat indefinite title "How Ferns Grow," the author refers mainly to the changes that occur in the succession of leaves from the cotyledon of the sporeling to the mature leaf of the sporophyte. It is suggested that in addition to the possibility of tracing phylogeny by means of ontogeny, a knowledge of the successive stages is likely to be of importance in the determination of species and varieties. These ideas are not, however, followed up, nor does the author offer the deductions that would be expected after the examination of a large number of series of young plants. From the illustrations it appears that a reniform shape characterises the earliest leaves of *Pellaea atropurpurea*, and the juvenile leaves of *Onoclea sensibilis* are somewhat similar; also the early leaves of the hart's-tongue and the walking fern, *Camptosorus rhizophyllus*, show similarity. But the figures given and the number of species examined are too few to permit of much, if any, generalisation.

Books on plant life are becoming numerous, too numerous, and yet books on the subject suited to the special requirements of different schools are not obtainable. Of the various books written for children in elementary schools, the "Study of Plant Life," by Miss Stopes, is quite the most logical and intelligent that we have seen.

Beginning with the physiology of the plant, the first object is to show that a plant lives, that it breathes, eats, grows, and moves. These functions are severally made apparent by simple experiments that can for the most part be carried out by children, and are explained with due care to impress their significance. The parts of the plant body and their uses are then discussed, and this prepares the way for the descriptions of their more marked and common modifications. The fourth part briefly enumerates the characters of the five great classes of plants. Passing to the consideration of plants in their homes, typical plant formations are described, and finally it is indicated how a botanical survey is made and plotted.

The foundation of the book is laid in the first part, treating of the plant's vitality, where the argument is well set out. The only suggestions that occur are of a minor nature, such as recommending other plants,



Victoria Regia in a public park in Minnesota. Reduced from an illustration in "The Romance of Plant Life."

the fuchsia or *Eupatorium adenophorum*, rather than the vine for root pressure, directing attention to the necessity of setting up a large number of culture solutions, &c. Throughout the book it will be found that the information is essentially clear and practical, the specimens selected for study easily obtainable, and the arrangement well balanced. While the figures generally are good, the plates illustrating water-plants and bladder-wrack are specially clever reproductions, altogether the book provides an admirable presentment of botanical instruction for children.

"Plant Life," by Mr. H. C. Jones, in contrast with the last, provides a series of notes on suitable work for nature-study classes.

It is divided into two portions, the first referring to plant life in the garden, the second to plant life in the school. The former includes chapters on twigs, bulb beds, insect fertilisation, underground stems and roots,

[1] "How Ferns Grow." By M. Slosson. Pp. vii+156. (New York: Henry Holt and Co.; London: Geo. Bell and Sons, 1906.) Price 12s. 6d. net.

"The Study of Plant Life for Young People." By M. C. Stopes. Pp. xii+202. (London: de la More Press, 1906.) Price 2s. 6d. net.

"Plant Life: Studies in Garden and School." By H. F. Jones. Pp. xii+260. (London: Methuen and Co., n.d.) Price 3s. 6d.

"The Romance of Plant Life." By G. F. Scott Elliot. Pp. 380. (London: Seeley and Co., 1907.) Price 5s.

"The Green Gateway: a Peep into the Plant World." By F. G. Heath. Pp. xi+138. (London: The Country Press, n.d.) Price 3s. net.

creeping plants, and other modifications Strange to say, modifications of flower form are omitted except in the occasional notes The second is a physiological course dealing with the energies of the plant This is more systematic in arrangement, and the experiments are tersely explained, but no new ideas or special hints are offered The methods suggested for setting up some of the experiments are by no means the most practical, to mention only the growing of a seedling in a funnel, or extracting chlorophyll by boiling the leaf in alcohol over a Bunsen flame As an indication of observational and experimental work that can be performed with simple apparatus, the book will be found serviceable, and the appendix contains a useful list of plants for growing

Mr Scott-Elliot brings to his subject an extensive knowledge of the ways of plants, and the instinct of imagination that enables him to appreciate the romance connected with the facts he has collected He relates, however, no tales so fascinating as the accounts one has read of the adventures of collectors in quest of orchids or other rare plants, nor is any attempt made to depict that most attractive of all phases of plant life, the tropical forest The author has selected most of his scenes from non-tropical regions, except where he writes of mangrove swamps and deserts The various relationships between animals and plants, specialisations of flowers, fruit and seed, and of the plant generally are among the subjects treated and economic botany receives a due share of recognition There is no want of variety in the book, in fact, the fragmentary nature of the subject-matter constitutes its chief defect, and much of the information whets the appetite for more The author has, we think, produced his best results where, as in the sketch contrasting ancient and modern Britain, he pursues a continuous topic

As a compilation of curious facts about plants, spiced with occasional grains of humour and light caustic satire, the reader will find much of passing interest and not a little that is worthy of closer attention The best illustrations represent economic scenes, but a more romantic subject is shown in the picture reproduced on the preceding page

There are various ways of appealing to the youthful mind, that adopted by the author of "The Green Gateway" being to arouse interest by copious allusions to magic, fairy work, and jewels Although fairy tales may be useful to stimulate the imagination, it is doubtful whether they form a suitable medium in which to portray science A tree and its parts form the central subject of the book, but it is probable that children will be most interested in the tales of the animal inhabitants and visitors of the tree, that are attractively described without reference to fairies and magic

PROF A F W PAULSEN

It is with great regret that we chronicle the death of Prof Adam F W Paulsen, which occurred in Copenhagen on January 11 Born in 1833 at Nyborg, in the island of Funen, Paulsen studied at the University of Copenhagen, in which town he subsequently held the position of professor of physics at the Lycée In 1884 he was appointed director of the Danish Meteorological Institute, one of the most important official meteorological positions, in view of the fact that the Danish Institute is responsible for the meteorological organisations of Greenland and Iceland, He was also a member of the Permanent International Meteorological Committee

Among Prof Paulsen's most important scientific labours must be reckoned his researches on the aurora borealis His attention was first actively directed towards this phenomenon during his stay at Gothaab in 1882–3 as head of a scientific expedition sent out by the Danish Government The question of the aurora remained one of absorbing interest to Paulsen, and in 1899–1900 he obtained from the Government the means for equipping an expedition to visit Iceland for the purpose of studying the spectrum of the aurora with the aid of modern photographic methods At the comparatively advanced age of sixty-six years he assumed personal command of the expedition, and brought back with him some highly interesting results He read a brief account of these before the British Association at the Southport meeting in 1903, which he attended as a member of the Permanent International Meteorological Committee

As director of the Danish Meteorological Institute, Prof Paulsen was the head of that meteorological organisation of which the area of observation lies nearest to the North Pole He never ceased to point out the intimate connection which exists between the meteorological conditions of Greenland and Iceland and those prevailing over Europe, and it is largely owing to his efforts that after many years of discussion and negotiation Iceland has at length been brought into telegraphic communication with Europe The daily service of meteorological messages which was established shortly before his death is likely to prove of great value both in the practical matter of forecasting and in the study from the scientific point of view of the permanent Icelandic low-pressure system and its influence on the weather of north-western Europe

Prof Paulsen was a familiar figure at international scientific meetings where his charm of manner, combined with great accuracy of judgment and a clear mode of expression, rendered him deservedly popular His last visit to this country occurred in the summer of 1904, when he attended the meeting of the International Association of Academies as delegate of the Royal Danish Society of Sciences

NOTES

At the annual meeting of the British Science Guild to be held at 4 p m on Monday next January 28, at the Mansion House under the presidency of the Lord Mayor, the Right Hon R B Haldane will deliver an address in relation to the work of the Guild Other speakers will probably be the Hon and Rev F Lyttelton, Sir David Gill, Sir Wm Mather Sir Henry Roscoe Sir Philip Magnus, M P Prof Meldola Mr A Haworth M P, Mr Mosely, and Mr Verney

We regret to see the announcement that Miss Agnes M Clerke, the gifted author of several well known works on astronomical subjects, died on January 20 at the age of sixty-four years The first important work on astronomy written by Miss Clerke was the "Popular History of Astronomy during the Nineteenth Century," published in 1885 Other works of outstanding merit are "The System of the Stars" (1890) and "Problems in Astrophysics" (1903) Her command of language and acquaintance with astronomical literature were extraordinary and empowered her to produce books distinguished by literary finish as well as by scientific value Miss Clerke was a most industrious compiler of methods and results of astronomical investigation The "History of Astronomy" was her most valuable contribution to scientific literature and her later works, though marked by the same inspiring style dealt with the more special aspects of astrophysics In

reading these works, it is impossible not to feel regret that an enthusiasm so great should have lacked the advantage of a laboratory training, which would have enabled Miss Clerke to estimate the real value of the various researches successfully recorded "No one writing a history of modern astronomy," says a correspondent of the *Times*, "can fail to acknowledge the great debt owed to the masterly array of facts in her 'History' No worker in the vast field of modern sidereal astronomy opened by the genius of Herschel and greatly widened by the application of the spectroscope to the chemical and physical problems of the universe lacked due recognition by Miss Clerke, who performed as it seemed no other writer could have done the work of collation and interpretation of this enormous mass of new material, ever pointing the way to new fields of investigation, often by one pregnant suggestion sweeping aside a whole sheaf of tentative conjectures and indicating, if not the true line—for in many cases the truth is yet to seek—at least a plausible and scientific line well worth pursuing"

THE Rothamsted Experimental Station (Lawes Agricultural Trust) has received a donation of 2000*l* from the Permanent Nitrate Committee, to be invested and added to the general endowment fund of the station A donation of one hundred guineas has also been received from the Fertiliser Manufacturers' Association During the past summer the station entered into occupation of the "James Mason" Bacteriological Laboratory, the gift of Mr J F Mason M P The society for extending the Rothamsted experiments, which was formed to obtain funds wherewith the experimental station might enlarge the scope of its work and initiate further agricultural investigations, has further received during the past year subscriptions and donations amounting to 240*l* Further subscriptions are still urgently needed to secure a more adequate staff, and may be addressed to the Secretary of the Rothamsted Experimental Station Harpenden, Hertfordshire

A REUTER message from The Hague, dated January 22, reports that a wave has destroyed the southern coast of the island of Simalu, near Sumatra The island of Simalu has nearly disappeared Violent earthquake shocks have occurred daily

A REUTER telegram from Vyernyi (Turkestan) states that the eclipse of the sun on January 14 was not observed there owing to cloudy and foggy weather

THE second National Poultry Conference will be held on July 9-11 at University College, Reading The honorary secretary of the conference is Mr Edward Brown, 12 Hanover Square, W

DR H R MILL has been elected president of the Royal Meteorological Society for the ensuing year, and Mr F C Bayard and Mr H Mellish secretaries of the society At the annual general meeting of the society on January 16 Mr Richard Bentley, the president, on behalf of the members of the council, presented an illuminated address to Mr William Marriott in recognition of his services as lecturer

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 9 and 10 The annual dinner will be held—under the presidency of Sir Hugh Bell, Bart—in the Grand Hall of the Hotel Cecil on May 10 The council will shortly proceed to award Carnegie research scholarships, and candidates must apply before February 28. The awards will be announced at the general meeting

THE Explosives in Coal Mines Order of December 17, 1906, has been issued by the Home Office in the form of a pamphlet of sixty-six pages (price 4½d) It contains full details of the composition of the fifty-eight explosives the use of which is permitted in unsafe collieries if certain specified conditions be observed

THE pipe line conveying petroleum from Baku to the Black Sea has been completed It is 550 miles long, and is capable of passing 400,000,000 gallons of oil yearly. Another important oil-pipe line has been built for transporting Texas and California petroleum across the Isthmus of Panama It is 8 inches in diameter and fifty-one miles long

ON Tuesday next, January 29, Prof A C Seward will commence a course of two lectures at the Royal Institution on "Survivals from the Past in the Plant World," and on Thursday January 31, Major P A MacMahon will deliver the first of two lectures on "Standards of Weights and Measures" The Friday evening discourse on February 1 will be delivered by Sir Almroth E Wright, on "The Methods of Combating the Bacteria of Disease in the Interior of the Organism"

THE thirty-eighth general meeting of the German Anthropological Society will be held in Cologne in August next It is proposed that this meeting should be constituted an international congress, and the Cologne Anthropological Society has issued a cordial invitation to fellows of the Anthropological Institute and others interested in anthropology and archæology to attend the congress It is further proposed to arrange a tour of two or three weeks in the Low Countries and France to take place after the congress During this tour places of the greatest interest from an anthropological point of view will be visited In case a section of the visitors would prefer to make a tour in Germany, the authorities state that they will consider the possibility of carrying out any proposition they may receive A complete programme will be published very shortly Meanwhile, fellows of the institute and other students of anthropology and archæology who would like to attend this congress are requested to communicate with the secretary of the Anthropological Institute, 3 Hanover Square, W

THE Faraday Society, the object of which is to promote the study of electrochemistry, both pure and applied, and also the study of chemical physics, is endeavouring to develop this latter side in the hope that the physical-chemical work done in this country may be published in its Transactions instead of being published in various Journals, and much of it abroad With this object in view the society held a meeting on January 15 to discuss the electron theory as applied to conduction in electrolytes, and on Tuesday, January 29, there will be a meeting at which a general discussion on osmotic pressure will take place Prof Armstrong will be in the chair, and the Earl of Berkeley will exhibit and describe his apparatus for the direct measurement of osmotic pressure Mr W. C D Whetham will speak on indirect methods of measuring osmotic pressure, Dr T M Lowry on osmotic pressure from the standpoint of the kinetic theory, and a paper by Prof Kahlenberg is expected upon the bearing of osmotic-pressure experiments upon the conception of the nature of solutions The society invites all who are interested in the subject to be present The meeting will be held, as

usual, in the library of the Electrical Engineers, 92 Victoria Street, S.W.

A RECEPTION and exhibition of recent progress in science was held by the New York Academy of Sciences in conjunction with the American Museum of Natural History on December 28 and 29, 1906, and, for the benefit of the public, the exhibition was continued daily until January 14. The 353 exhibits were arranged in eighteen sections, covering nearly every department of natural knowledge, and the exhibition as a whole was a tribute to the organising powers of the managing committee. The New York Academy of Sciences is one of the oldest among American societies, having been established in 1817 as the Lyceum of Natural History. It embraces all branches of science; its scope, in fact, is similar to that of the older European societies. Its publications have long been familiar to readers of NATURE. Its membership includes a maximum of fifty honorary members elected from representative men of science throughout the world, more than 200 corresponding members, who are expected to communicate the results of their researches to the academy from time to time, and the active and associate members. Active membership is not restricted to specialists, but is open to those who take a general interest in science. Fellows are chosen from among the active members in recognition of scientific attainments or services.

A DEPUTATION representing the Infants' Health Society waited upon Mr. John Burns, M.P., President of the Local Government Board, on January 17, with reference to the supply of sterilised milk to infants. Several local authorities have recently established depôts for the supply of sterilised milk for infant feeding. The opinion has been expressed that in so doing the authorities have exceeded their legal powers, and Mr. Burns has therefore intended to introduce a Bill to legalise their action. The Infants' Health Society, believing that sterilisation is of doubtful value, and that refrigeration is preferable, asked that before sterilisation was sanctioned an investigation should be made by a committee of experts which it is proposed to form. Sir Thomas Barlow, Sir Lauder Brunton, and Mr. Mayo Robson having detailed the views of the society, Mr. Burns in reply said that he knew that sterilisation was not the last word in dealing with the problem of the milk supply, and at present he saw no reason why a choice should not be given between the two methods of sterilisation and refrigeration, and why he should not embody in his Bill the power being given to local authorities to sterilise milk. With regard to the investigation of the question by a joint committee, he would be glad if such a committee would communicate to him the results of their investigations.

THE valuable collection of British and foreign Algæ made by Mr. E. M. Holmes, of the Pharmaceutical Society, has, through the generosity of Mr. William A. Cadbury, been acquired for the botanical department of the University of Birmingham. The collection is a very large one, including about 13,000 specimens, and constituting the produce of more than thirty years of Mr. Holmes's activity as a collector. The British portion of the collection is of exceptional value, owing to the singularly prolific nature of Mr. Holmes's personal investigations. When he commenced his work thirty-five years ago there were some 400 species of British marine Algæ known. There are now about 750, and 225 of the new species were distributed by Mr. Holmes himself, in eleven fasciculi. Of these, twenty-five sets only were issued, and with three or four exceptions these sets were acquired for national collections or British or foreign universities. As some of the best collecting grounds of the past, such as those near Weymouth, Plymouth, and Falmouth, have been in large measure spoilt by extensions of building areas, the difficulties in the way of making a complete collection are of increasing magnitude, while three or four of the specimens included in the collection are unique. The foreign portion of the collection is as complete as could have been made in the period, and includes authentic sets sent out by all the best known algologists, such as Harvey, Agardh, Bornet, Thuret, Crouan, Ferguson, and others. Here also not a few of the specimens are types, having been used as the basis of published specific descriptions. As Mr. Holmes had long planned that his collection should be fitted for public rather than private ownership, exceptional care has been taken throughout in respect of display and mounting, and different species or different varieties are in no case included upon the same sheet. The donor also states, as a condition of gift, that the collection shall be accessible to algologists generally for any purposes of serious study or of reference.

BRITISH sea fisheries, and more especially those of the North Sea, form the subject of an instructive article in the January number of the *Quarterly Review*. After a survey of the results of earlier investigations the author discusses those of the last three or four years, which are based on much more precise information than was available in the case of the former. Starting with the axiom that a given area of the sea can nourish only a limited amount of fish, it is pointed out that if the methods of capture tell more heavily on one kind than on another it is quite probable that valuable species may be largely displaced by inferior ones. This seems to be the condition of affairs in the North Sea, where the worthless dab is increasing at the expense of the plaice. Possibly the remedy for this is the introduction of young plaice. Subsequently, in discussing the excessive destruction of young fish which undoubtedly takes place, the question is raised whether this has really any marked effect on the adult population; certainly it does not appear to do this in the case of the herring. Be this as it may, it seems clear that the Grimsby supply is largely maintained by drawing on immature fish. Admitting this, it has yet to be proved that the destruction of young plaice is not the consequence rather than the cause of the depletion of the grounds. If this be so, it follows that the undersized-plaice problem must be considered from a fresh standpoint—the expectation that by checking the capture of young fish the sea will be replenished being obviously untenable. Apart from the grave condition of that of the North Sea, the author expresses the opinion that the condition of British fisheries generally was never better than at present. Obviously, however, interference of some kind must eventually be necessary in nearly all cases, and if this be so it is of the utmost importance that our knowledge of the fishery problem in all its aspects should be made as nearly as complete as possible while prosperity lasts. The Government is, therefore, urged to increase rather than slacken its efforts and support.

IN connection with the preceding note it may be mentioned that there has been recently installed in the central hall of the Natural History Museum an exhibit prepared by the Marine Biological Association, Plymouth, to illustrate the growth of plaice and pollack, and the methods of ascertaining the ages of individual specimens of each

In the case of the former, the age estimate is made by counting the annual rings of growth in the ear-bone or otolith, whereas in the latter the scales are employed for the same purpose. Enlarged photographs of these structures in the two species are exhibited.

THE Colonial Office has just issued a report of the advisory committee of the Tropical Diseases Research Fund for 1906. This committee was constituted in July, 1904, and consists of Sir T. Barlow, Sir M. Foster, Sir P. Manson, Sir R. Moor, Surgeon-General Bransfoot, and Messrs. Holderness, Lucas, and Read, with Sir West Ridgeway as chairman. The revenue of the fund for 1906 amounted to 3000*l.*, and was made up of contributions from the Imperial Government, Government of India, Rhodes trustees, and various Colonial Governments. The expenditure consisted of a grant of 500*l.* to the Liverpool School of Tropical Medicine, of 1000*l.* to the London School, of 750*l.* to the University of London, and of 500*l.* to the Royal Society. The report includes summaries of work done during 1906. Mr. Leiper, the helminthologist of the London School, has investigated the life-history of the *Dracunculus medinensis*, or guinea-worm, the cause of a disease widely disseminated in tropical Africa. The embryo, after leaving the human body, develops into larvæ, which enter the body of a small fresh-water crustacean of the genus Cyclops. The larvæ do not spontaneously leave the Cyclops, but if the crustacean be treated with 0.2 per cent. hydrochloric acid it dies and the larvæ are awakened into activity and escape. This suggests that man is infected by swallowing water containing infected Cyclops, and by feeding monkeys with infected Cyclops guinea-worm infection was produced. Dr. Wenyon describes a new species of spirochæte of the mouse, and summaries of investigations on the value of arsenical preparations in sleeping sickness and on other subjects are also given.

No. 9 of the *Kew Bulletin*, completing the volume for the past year, contains a list of marine algæ from Corea, by Mr. A. D. Cotton, and a decade of new orchids named by Mr. W. L. Rolfe. Mr. W. B. Hemsley communicates a note on a new fruit from Uruguay, about the size and shape of a very small apple, having an agreeable taste and said to possess remarkable digestive properties. The plant belongs to the Sapotaceæ, and receives the name of *Pouteria suavis*. Short notices of the dye substance known as barwood, now referred to *Pterocarpus Soyauxii*, and varieties of the Chinese drug, "huan-ch'i," furnished by species of Astragalus, are contributed by Mr. J. M. Hillier and Mr. E. H. Wilson.

A PAPER on the planting of high moorlands appears in the Transactions of the Royal Scottish Arboricultural Society, vol. xx., part i., wherein the writer, Sir John Stirling Maxwell, advocates a Belgian system of utilising the turfs cut out from the drains as mounds in which to plant out seedlings. A variety of *Pinus montana*, grown largely in the Pyrenees, is mentioned as a tree that is likely to grow well on high moorland. Dr. R. S. MacDougall contributes an entomological article on the life-history of the large larch sawfly, *Nematus erichsoni*, and Mr. E. S. Grant describes a method of trapping the pine weevil *Hylobius abietis*. A useful set of measurements indicating the increase during fourteen years of a larch crop growing at Murthly, Perthshire, is given by Mr. A. Murray, and a table for the amount of creosote absorbed by various timbers is furnished by Mr. W. B. Havelock.

IN the *Journal de Physique* for December, 1906, M. U. Schoop describes experiments for determining the lines of flow in electrolytes and the distribution of currents in accumulators. The method consists in using an analyser formed of two electrodes of spongy platinum placed close together and connected with a galvanometer; when the electrodes coincide in direction with the equipotential lines no deviation is shown. In this way the lines of the field are capable of being plotted, and a further experimental method enables the intensity of the current to be found at different points.

IT has been shown by Lord Rayleigh that there are certain cases in which an oscillation can be maintained or intensified by a periodic force of double its frequency, as, for example, a stretched string excited by a longitudinal force of half the period of lateral vibration. In the *Quarterly Journal of Mathematics*, 148 (1906), Mr. Andrew Stephenson extends this result by discussing cases in which the ratio of the frequencies, instead of being 2, is one of the numbers 1, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{2}{5}$, &c., i.e. a fraction having 2 as its numerator.

IN the Manchester Memoirs, l. (190), 8, Mr. R. F. Gwyther discusses the range of Stokes's progressive waves of finite amplitude. By studying the paths of the fluid particles, the author shows that the class of wave in question is capable of indefinite propagation with uniform velocity; moreover, the motions of the particles can be determined, within a certain range, to any required degree of accuracy by means of series. There is a limit to the height of the waves when their profile shows a finite angle at the crest, and this "highest wave" is the same as that investigated by Mitchell in 1893.

THE interest taken by American mathematicians in what is done in other countries is well illustrated by Prof. Virgil Snyder's short article on the mathematical tripos of 1906 in the Bulletin of the American Mathematical Society for December, 1906. The article contains an outline of the general characteristics of the various parts of the tripos and the number and subject-matter of the papers in each part. It is illustrated by specimens of the papers reprinted by permission, one in applied mathematics from the first four days, one in pure mathematics from the higher part of part i., and one on divisions ii.–iv. from part ii. Reference is made to the fact that in part i. the "riders" generally have only a very distant connection with the bookwork.

THE "Notes in Mathematics" edited by Prof. Morley, form a pleasing addition to the dry details of class-lists and time-tables published in the Johns Hopkins University Circular, 1906, No. 9. The notes in question deal with the linear relations among the minors of symmetric determinants, by Dr. A. B. Coble, the use of a special type of rational curve (the De Jonquières curve) for the illustration of binary syzygies, by Mr. A. E. Landry, curves with a directrix, by Mr. Clyde S. Atchison, and a note on the determination of multiple points of rational algebraic curves, by Mr. H. Ivah Thomsen. These notes bear testimony to Prof. Morley's activity in organising university research, more especially seeing that the *American Journal of Mathematics* is also issued under his editorship by the Johns Hopkins Press.

A RECORD has been set up in Bendigo for the greatest depth at which gold has been found, gold ore having been struck in driving a cross-cut at 4254 feet at the Victoria quartz mine. The record find in depth previously was held by the New Chum mine, at 4226 feet.

We have received from Dr G F Kunz a collection of papers relating to the lilac-coloured spodumene, known as kunzite, from California These spodumene crystals are of extraordinary size, transparency, and beauty, and the various papers recording the remarkable discovery were noticed in NATURE in 1903 (vol lxviii, p 460)

THE magnificent collection of jadeite and nephrite presented by the late Mr Heber R Bishop to the Metropolitan Museum of Art of New York has, as stipulated in the gift, been duly catalogued The exhaustive catalogue, of which only one hundred copies have been prepared, is described by Dr G F Kunz in the Bulletin of the Metropolitan Museum of Art, 1906 It covers a thorough investigation of the subject. No copies were sold, the entire edition having been distributed amongst the important public institutions of the world

PROF W GALLOWAY, who has invented many valuable improvements in mining methods and machinery, has devised an ingenious apparatus for automatically stopping and re starting mine waggons and recently read a paper describing the invention to the North of England Institute of Mining Engineers (Newcastle-upon-Tyne, 1906) The points at which this appliance can be most usefully employed are at the weighing machine between the top of the shaft and the screens, and in front of the cage at the top and bottom of the shaft By it all the weighing on the surface and the loading and unloading of the cages have been effected automatically for upwards of a year at a colliery in South Wales

AT the *Institution of Mining and Metallurgy* a paper was read on January 17 by Mr E A Smith on the assay of silver bullion by Volhard's ammonium thiocyanate method It has recently been the practice to modify slightly the method of finishing the assay by adding sufficient ammonium thiocyanate to the check assay to intensify the red colour of the ferric thiocyanate, and to use this colour as a standard of comparison Experiments described by the author proved that, by finishing the assay in this way, a limit of accuracy of less than 0 1 per 1000 of silver can be obtained by Volhard's method Working in the ordinary way, the limit of accuracy is 0 2 to 0 3 per 1000

ATTENTION was directed by Mr Bennett H Brough in his lectures on perils underground (Journal of the Society of Arts, January 11) to the fact that, whilst from time to time some terrible colliery explosion occurred claiming scores of victims at once, every-day fatalities from falls of roof added up to a far higher total This statement is strikingly borne out by the Home Office tables of fatal accidents and deaths in and about the mines and quarries of the United Kingdom during the year 1906, of which we have received an advance proof The total number of deaths caused by explosions of fire-damp or coal-dust was fifty-four, and that caused by falls of ground was 547 Of other deaths, sixty-eight were due to shaft accidents, 329 to miscellaneous accidents underground, and 135 to accidents on the surface Altogether there were 1133 deaths from accidents as compared with 1159 in 1905

MR P E RADLEY, of 30 Theobald's Road, London has compiled and published at one penny a booklet of 64 pages dealing with metric and English weights and measures The publication may be regarded as a modern "table book," and should serve to popularise the decimal system of coinage and weights and measures generally

IN the *Times* of January 15 Dr H R Mill gives the results of a preliminary discussion of the rainfall observations of the British Isles during the past year The production of such a general summary in so short a time is at least a remarkable performance, and highly creditable to the British rainfall organisation, the preparation for final publication, after careful scrutiny, of some 4000 records will take about six months to complete Dr Mill states that the year 1906 was not remarkable with respect to annual rainfall "unless it be remarkable to coincide almost exactly with the average, the portions of the country which were unduly wet compensating for those which were unusually dry" This remark calls to mind one made by Dr Shaw, referring to the *Weekly Weather Report*, at one of the recent useful discussions at the Meteorological Office, viz that the *average* value was apparently one not very likely to occur The mean of the percentage figures given in Dr Mill's diagrams shows that the general rainfall of England and Wales was exactly the average, while that of Scotland shows an excess of 9 per cent, and that of Ireland a deficiency of 4 per cent The special monthly features were principally a wet January and dry April in the south of England, a wet May in Scotland and the north of England, a storm with excessive rainfall in the south-east half of England on June 28, a very dry summer (with the exception of a wet August in Scotland), a wet October, and heavy snowfall near the end of December

WE have received a copy of the January issue of Mr C Baker's (244 High Holborn) classified list of second-hand instruments Men of science and teachers who are requiring microscopes, surveying instruments, telescopes, spectroscopic apparatus, barometers, or other instruments or accessories will do well to examine this catalogue

MESSRS REYNOLDS AND BRANSON, LTD, of Leeds, have sent us a series of their recent issues of illustrated catalogues of chemical and physical apparatus which they are prepared to supply Every requirement of the teacher of science and of the investigator appears to have been borne in mind in preparing the catalogues which are models of clear arrangement for easy reference

MESSRS LONGMANS, GREEN AND CO have issued an abridged edition of the late Mr F W H Myers's "Human Personality and its Survival of Bodily Death" The abridgment and editing have been done by Mr Leopold H Myers The original work was reviewed at some length by Sir Oliver Lodge, F R S, in our issue of June 18, 1903, and readers may be directed to the account there given of the line of argument followed by Frederic Myers The price of the present book is 10*s* 6*d* net

AN address on the "Modern Theories of Electricity and their Relation to the Franklinian Theory," delivered in Philadelphia by Prof E Rutherford at the celebration in April of last year, under the auspices of the American Philosophical Society, of the 200th anniversary of the birth of Benjamin Franklin, is published in the official record of the celebration In his address Prof Rutherford gave a comprehensive review of the development of the conceptions which have been formed of positive and negative electricity from the time of the one fluid theory of Franklin to the present day, and briefly summarised recent views of the constitution of matter from the standpoint of the theory of electrons

OUR ASTRONOMICAL COLUMN

THE PROPER MOTION OF CASTOR.—Taking into account both the true proper motion and the orbital motion of the system of Castor, Mr. Crommelin has determined a new value for the proper motion of the centre of gravity of the system. This new value is −0·01358, +0″·120, and it represents the facts much more closely than those previously determined by Auwers and Newcomb respectively. In fact, the latter would have become entirely erroneous in N.P.D., within a few years, for they were based on the assumption that the proper motion was uniformly rectilinear, whereas the orbital motion in N.P.D. will, in a few years, be entirely reversed. It is interesting to note that the new value was obtained by taking into account the spectroscopic as well as the meridian-observation results, and that the mass ratio obtained by Dr. H. Curtis, which shows that the mass of α1 is six times greater than that of α2, is hereby confirmed (Monthly Notices R.A.S., December, 1906).

LINE INTENSITY AND SPECTRAL TYPE.—The results of an interesting investigation of compound lines shown on the stellar spectrograms obtained at the Mills Observatory, Chile, are published in No. 5, vol. xxiv., of the *Astrophysical Journal* by Dr. Sebastian Albrecht. From the spectrograms of stars of different types it was found that certain compound lines give progressive differences in the determined radial velocities as one passes from the type F to the type Mb in the Harvard classification. The investigation showed that these differences are probably due to the variation of intensity, rather than the presence or absence, of the same components of the blended line in passing from one stellar type to another. It also showed that, considering the origins of the variable lines, the physical conditions in the stars as we pass from the F (Procyonian) to the Mb (Antarian) type vary roughly in the same direction as from the sun to the sun-spots, a conclusion confirming that arrived at by Sir Norman Lockyer (Proc. Roy. Soc., vol. lxxiv., p. 53) in a paper which does not appear to have been noted by the American observers who have since dealt with this subject.

The awkwardness of having an arbitrarily chosen code, instead of self-explanatory generical names, to represent stellar types, is strikingly illustrated in the present paper, where the reader's mind is constantly taxed in trying to remember the significance of such signs as Ma, K_5M, F_8G, and so on.

SILICON IN THE CHROMOSPHERE.—At the last meeting of the Royal Astronomical Society Mr. Fowler read a paper in which he demonstrated the probable presence of silicon in the chromosphere. This element was identified by the presence of two of its strong lines, λ 6347·3 and λ 6371·6, as well-marked lines in the chromospheric spectrum. Both lines occur in the Fraunhofer spectrum, with intensities and characters 2N and 1Nd? respectively, and the latter was ascribed to iron by Rowland, who failed to find an origin for the other. Both are probably enhanced lines, and are almost obliterated in the sun-spot spectrum (Monthly Notices, No. 2, vol. lxvii.).

VARIATION OF WAVE-LENGTHS IN THE SOLAR SPECTRUM.—Whilst discussing his 1901–6 observations of the sun's rotation period Dr. Halm discovered a previously unknown "shift" in two of the spectrum lines employed. The method used at Edinburgh is that in which the difference of the interval between certain solar and atmospheric lines at the sun's centre and at the limb is measured, this difference giving the "Doppler" displacement at the limb due to the sun's rotational motion. Dr. Halm found that this interval was not the same in 1906 as in 1901, and on analysing his results further he also found some indication of a three-year period in the variation, thus giving additional confirmation to the existence of a short period in solar phenomena such as found by Dr. W. J. S. Lockyer when discussing the relations between solar and terrestrial meteorological phenomena. Dr. Halm suggests that the "shift" discovered by him may be due to difference of pressure (*Astronomische Nachrichten*, No. 4146).

MEETING OF THE AMERICAN ASSOCIATION AND ITS AFFILIATED SOCIETIES.

THE fifty-seventh meeting of the American Association for the Advancement of Science and of the societies affiliated with it was held at New York, N.Y., during the recent convocation week (December 26, 1906, to January 2), under the presidency of the distinguished pathologist Dr. William H. Welch, of Johns Hopkins University. The meetings brought together a larger number of scientific men than ever before, and it is estimated that about 1800 scientific men and women were in attendance. The meetings for the most part were held in the compact group of buildings forming the Morningside Heights property of the Columbia University, but the medical meetings of Section K (Physiology and Experimental Medicine) of the association, of the American Physiological Society, the American Bacteriological Society, and the American Society of Anatomists were held at the College of Physicians and Surgeons and at the Rockefeller Institute. The Geological Society of America and Section E (Geology and Geography) met at the American Museum of Natural History, and the Botanical Society of America and Section G (Botany) met at the Botanical Gardens. The opening meeting was held in Earl Hall, Columbia University, when the retiring president, Prof. C. M. Woodward, of St. Louis, introduced his successor, Dr. William H. Welch. An address of welcome was given by Dr. Nicholas Murray Butler, president of Columbia University, to which Dr. Welch responded.

The address of the retiring president, Prof. Woodward, was delivered at the Teachers' College on Thursday night, December 27, 1906, and was entitled "The Science of Education," a peculiarly apt topic for this meeting, since a new section, "L—Education," was founded at this time.

The addresses of vice-presidents, that is, the chairmen of sections, were extremely interesting. On Thursday afternoon Vice-president Ward, in his address before the Section of Zoology, used as his subject "The Influence of Parasitism on the Host"; Vice-president McNair, before the Section of Mechanical Science and Engineering, spoke on "Some Problems Connected with Deep Mining in the Lake Superior Copper District"; Vice-president Fisher, before the Section of Social and Economic Science, spoke on the topic "Why the *Laisser-faire* Doctrine Failed"; Vice-president Rice, before the Section of Geology and Geography, spoke on "The Contributions of America to Geology"; Vice-president Sedgwick, before the Section of Physiology and Experimental Medicine, spoke on "The Expansion of Physiology"; Vice-president Eichelberger, before the Section of Mathematics and Astronomy, had as his title "Clocks—Ancient and Modern"; Vice-president Mabery, before the Section of Chemistry, spoke of the "Education of a Professional Chemist"; Vice-president MacCurdy addressed the Section of Anthropology on the subject of "Some Phases of Prehistoric Archæology"; Vice-president Crew, before the Section of Physics, spoke on "Fact and Theory in Spectroscopy"; and Vice-president Smith, before the Section of Botany, under the title "Problems in Plant Pathology."

One of the most interesting and important features of the meeting was the holding of a number of joint sessions between different societies and sections. For example, the afternoon of December 27 was devoted to a symposium under the auspices of Section K (Physiology and Experimental Medicine) at the College of Physicians and Surgeons on the subject of protozoa as factors in disease, a discussion in which both the pathologists and the botanists joined. On the following day a joint meeting of the Society of Zoologists and the Sections of Zoology and Botany was held for the reading of papers on heredity in plant and animal breeding, and on that day Section K held a joint meeting with the Society of American Bacteriologists. There was also a general discussion under the auspices of the American Society of Naturalists on the general topic "The Biological Significance and Control of Sex." On the same day a new Entomological Society of America was founded, with nearly 200 members, and a public lecture was delivered under its auspices by Dr.

Wm M Wheeler, on "The Polymorphism of Social Insects."

On Saturday, December 29, a general meeting and luncheon was given at the College of the City of New York, where lectures were given on "The Effort to Save Niagara," by Dr John M Clarke, and "On the Industries of Niagara," by Prof C. F Chandler In the afternoon a general meeting was held at the American Museum of Natural History to attend the ceremonies connected with the unveiling of the busts of American men of science presented to the museum by Mr Morris K Jesup Five-minute speeches of presentation were made by Dr H C Bumpus, Hon Joseph H Choate, Dr S Weir Mitchell, the representative of the German Ambassador, Dr C Hart Merriam, Dr N L Britton, Dr R S Woodward, Dr Arthur T. Hadley, Dr Hugh M Smith, Dr W K Brooks, and Dr H F Osborn A reception was given at the museum in the evening by the trustees of the museum and the New York Academy of Sciences, with an exhibition of scientific progress by the academy, including a demonstration and short addresses

The most important actions taken by council and by the association at the New York meeting were as follows —(1) The addition of a new section to the association, viz L—Education, (2) the change of the title of Section H from "Anthropology" to "Anthropology and Psychology", (3) a standing committee of fifteen on seismology was appointed, (4) a Darwin memorial committee of ten was appointed to consider the manner in which the association may suitably commemorate the fiftieth anniversary of the publication of the first edition of "The Origin of Species," and this committee was authorised to make overtures to the British Association in order to ascertain whether joint action in this matter cannot be taken (5) the permanent secretary was authorised to publish hereafter in the official programme of the association all the programmes of all the affiliated societies, whether holding joint sessions with the sections of the association or not, (6) Section E and other sections desiring to do so were authorised to hold a summer meeting during the summer of 1907, (7) a memorial was presented to Congress urging the passage at the present session of the Bill creating forest reserves in the White Mountain region and in the Lower Appalachian region

In accordance with the policy adopted of recent years, the general committee chose as the place of next meeting the city recommended by the last general committee namely, Chicago, and recommended to the next general committee that the meeting of 1908–9 should be held in Baltimore A cordial invitation was received from the president of the University of Chicago, from the Field Columbian Museum and from the Mayor of the city, and also from the president of Johns Hopkins University, of Baltimore The alternation of eastern and mid-western meetings appears to be, on the whole, satisfactory, although the eastern meetings have been much more largely attended Chicago, however, is a great scientific centre, and is so easily accessible by rail that the next meeting bids fair to be a large one

The officers elected for the Chicago meeting were as follows —President, Prof E L Nichols Cornell University, Ithaca, N Y , *vice-president and chairman of Section A* (Mathematics and Astronomy), Prof E O Lovett Princeton University, Princeton N J , vice-president and chairman of Section B (Physics), Prof Dayton C Miller, Case School of Applied Science, Cleveland, Ohio, vice-president and chairman of Section C (Chemistry), Prof H. P Talbot, Massachusetts Institute of Technology, Boston, Mass , vice-president and chairman of Section D (Mechanical Science and Engineering), Prof Olin H Landreth, Union College, Schenectady, N Y , vice-president and chairman of Section E (Geology and Geography), Prof J P Iddings, University of Chicago, Chicago, Ill , vice-president and chairman of Section F (Zoology), Prof F B Wilson, Columbia University, New York, N Y vice-president and chairman of Section G (Botany), Prof C E, Bessey, University of Nebraska, Lincoln, Neb , vice-president and chairman of Section H (Anthropology) Dr Franz Boas, American Museum of Natural History, Central Park, New York, N Y , vice-president and chairman of Section I (Social and Economic Science), Dr John Franklin Crowell, c/o *The Wall Street Gazette*, New York, N Y , vice-president and chairman of Section K (Physiology and Experimental Medicine), Dr Ludwig Hektoen, University of Chicago, Chicago, Ill , vice-president and chairman of Section L (Education), Hon Elmer Brown, U S Commissioner of Education, Washington D C

SOME RECENT WORK OF GEOLOGICAL SURVEYS

THE Summary of Progress of the *Geological Survey of the United Kingdom* for 1905 (London H M Stationery Office, 1906, price 1s) contains new information regarding the granites of Cornwall and the results of subterranean vapour-action on their flanks The associated elvan-dykes are now recognised as cutting the granite, and not as offshoots from the more coarsely crystalline mass The Ordovician beds of South Wales are being divided into zones, under the care of Mr Strahan We may note that the spelling "Llandilo" is officially accepted At the same time, the Coal-measures of South Wales continue to receive close attention, and Messrs Gibson and Cantrill describe the progress of the search for coal beneath the Permian and Trias of the English Midlands Mr Flett's account of the Lewisian rocks that have been recognised within the area of the Moine gneisses in northern Scotland shows that the ancient intrusive gneisses are accompanied by still older rocks of sedimentary origin, which have been metamorphosed by them Following Dr Peach, the occurrence of an unconformity between this older complex series and the Moine gneisses is regarded as extremely probable (pp 103, 166 &c) Mr Howe furnishes a summary of the work done in the museum at Jermyn Street on the samples of road-metal tested in Mr Lovegrove's machines at Hornsey The full results are now available in a separate work (see NATURE, vol lxxv , p 220)

The Geological Survey also issued in 1906 a colour-printed edition of Sheet 110 of the English map, with the superficial deposits represented, and an accompanying memoir of 138 pages on "The Geology of the Country around Macclesfield, Congleton, Crewe and Middlewich" (price 2s 6d) The only things that we miss in this memoir are photographic illustrations to show the contrast between the drift-covered plain of Cheshire and the scarped and broken country leading northwards from Mow Cop Even a vignette of Moreton Hall, and another of the spoil-heaps of a coal mine, might express the social and industrial contrast, which is so well known to road-travellers between Chester and the Pennine Chain The "general description," however, makes good amends from the point of view of structural geology The details of the superficial deposits are the newest feature in the memoir, and the glacial beds are regarded as the product of an ice-sheet about 1100 feet in thickness (p 79) The marine shells found in the high-level gravels "may well have been caught up by the ice in its passage over the Irish Sea" Examples of these occur east of Macclesfield at a height of 1200 feet above the sea But Mr T I Pocock, who treats of this area in the memoir, believes that the shelly sands formerly to be seen under Macclesfield itself (p 84), at a height of about 450 feet, may have been deposited in a shallow sea The perfect state of preservation of large numbers of the molluscan remains and the absence of glacial indications in the beds, influence him in this opinion, which is quite in accordance with what is admitted in countries outside the British Isles At home, however, it is certain to be questioned as is also the dim suggestion of an inter-Glacial epoch in the succession of events tabulated upon p 88 The economic geology of the area is dealt with in chapter ix

Earlier in the year, Mr G Barrow's memoir on "The Geology of the Isles of Scilly" (price 1s) was issued to accompany a convenient map which includes the whole group in a single sheet Here photography has freely been called in, and the relations of the isles to human interests are well touched on Mr Flett's petrographic notes appear,

happily, in connection with the description of the rock-masses in the field An outlier of gravel (p 15), "largely composed of Chalk-flints and Greensand-chert," forms a cap on the eastern promontory of St Martin's, and may be a relic of a river-gravel, spread from Dartmoor over a continuous land-surface in Eocene times The old pre-Glacial beach, now near sea-level, has been raised at least 40 feet, and again lowered by that amount, since its formation (p 33), the evidence of this comes from the mainland, but is sufficiently conclusive The warping in the beach itself may be brought to the attention of those who are captivated by the theory of fluctuations in the volume of the sea rather than by that of recent movements of the land

Part iv of the *Administration Reports of Ceylon* for 1905 includes one on the Mineralogical Survey, by the director, Dr A K Coomaraswamy This raises a number of points of great interest to the petrographer as well as the mineralogist The graphite of Ceylon is regarded as a product of vein-filling processes following the reasoning of Weinschenk—here styled, as so often happens, Weinschenck If, however (p E3), the crystalline limestones of the district are organic, the graphite may possibly have had "an indirect organic origin" The similarity of the deposits in Ceylon to those of Quebec, which are directly associated with limestone, is not so great as Osann has recently suggested The discovery of thorianite by the director has led to investigations in a number of valleys (p E 6), but, knowing the country intimately, Dr Coomaraswamy does not believe that it would be practicable to divert the courses of the streams to facilitate the raising of the material An illustrated account is given of the native method of dredging for gems, and there is a fine plate showing the weathered surface of limestone associated with bands and lumps of granulite A parallel to this "interstreaking" of the two rocks can surely be found in the west of our own islands where the "granulite" is clearly an invader in the limestone This report, so closely and simply written, provides more agreeable reading than many ambitious volumes with wide margins and encyclopædic information

From the *New Zealand Geological Survey* we have received Bulletin No. 1, describing the geology of the Hokitika sheet, by J M Bell and Colin Fraser (pp xii+102, 1906) Some of the topographical work has to be carried out by the Geological Survey, and maps are usefully added in an envelope at the end of the bulletin The area described lies in North Westland, and contains both alluvial gold and coal The relics of formerly extensive glaciers, with snowy gathering-grounds at a height of about 5500 feet above the sea, afford especially interesting features in a latitude of 43° S One of these narrow shrunken glaciers is shown in the illustration here selected (Fig 1), and the memoir abounds in photographic views which will appeal equally to the geographer and the geologist. It should have been noted, perhaps, by the authors that some of these views represent more than the perpetual snow. On p 21 it is suggested that the glaciation began to spread from the new mountain-range "during or perhaps just following Lower Cretaceous times." On the next page this is, we think, corrected by the statement that "glaciation started in Miocene time" The great advance of the ice, reducing the island to the condition of Greenland, probably took place in the early Pleistocene Whether this was due entirely to the upheaval of a mountain-chain across the direction of the prevalent winds is left an open question We gather that the great mountain-building movements were of early Eocene age

The authors have no doubt as to the excavating power of the glaciers in the past, and quote the forms of the lake-bottoms in support of their conclusions. The petrology is illustrated by a striking series of enlargements from rock-slices, reminding one, on a still bolder scale, of the pioneer work of the late Sir R Daintree. Nephrite (p 69) is found occurring as segregations in talc-rock or talc-serpentine-rock, the lumps being from about 1 inch to 2 feet across, these are pointed out (p 99) as of economic value On p 93 we have the interesting suggestion that boulders of "grauwacke" in Butcher's Creek supply sufficient ferrous carbonate to act, when they decompose, as precipitants of gold in the solutions permeating the surrounding gravels These boulders were examined chemically, owing to the greater richness of the gravel round them as compared with that round boulders of other rocks. Another remarkable record is the discovery of platinum in quartz-veins (p 96) The whole bulletin, with its introduction on the botany, soil, climate, and communications of the area, shows that the survey has a high conception of its duties in carrying on the scientific investigation of New Zealand

The *Annual Report of the State Geologist of New Jersey* for 1905 shows the local survey in cooperation with that of the United States, and even competing with it in the

FIG 1—Grave Creek Glacier, with Mount Walter (6350 feet) at the back.

production of geological maps on a large scale (p 4). As is now the case with most surveys, economic observations occupy an important place, and it is doubtless found that the necessity for close scrutiny and all-round questioning which such inquiries involve reacts favourably on the character of the more purely scientific work In New Jersey, however, the Geological Survey goes outside ordinary lines, and deals, for instance, with water-supply and coast-protection from an engineering point of view Mr Berry describes (p 135) the Cenomanian flora of the Magothy beds at Cliffwood Messrs. Parmelee and McCourt contribute ninety pages on the nature and uses of peat, and on the peat-deposits of the State, with a general bibliography

The recent work of the *United States Geological Survey* has been dealt with lately in a special article (NATURE, December 20, 1906, p 182) Mr Calhoun has now issued a professional paper on "The Montana Lobe of the Keewatin Ice-sheet," which contains interesting details (p 40, &c) as to the influence of the main ice-sheet on the course of the Missouri River, Students of dry river-courses in glaciated areas will find the Shonkin Sag of interest, a channel with characteristically fresh surface-

features (Fig 2), and cut to a depth of 600 feet across and not down, the slope of a hillside for a length of eighty miles (pp. 12 and 43). This is explained by the action of an overflow-stream from a lake held in between the ice-front and the hills Parts of several pre-Glacial stream-outs were utilised in its course

The work of the *Geologische Reichsanstalt* of Vienna may conveniently be touched on in this article In vol lvi of the *Jahrbuch* of this institute (May, 1906, p 298) Dr Stuchlik attributes a lateritic origin to the "bunte Mollasse" of the Oligocene of southern Bavaria, and urges that the red ferruginous material was washed down from tropical deltas into a shallow sea. B Granigg's paper (p. 367) on the Ober-Möltal in Carinthia contains some observations on the origin of serpentine, and it is instructive to note that the intrusive masses from which this rock has been produced have metamorphosed the adjacent mica-schist and quartzite in very various degrees Contact-alteration is at times hardly perceptible, a fact that may be taken into account in the discussion on the origin of the South African diamantiferous material In the *Verhandlungen* of the Reichsanstalt, 1906, pp 146–164, Dr F E Suess gives a general account of the geology of the complicated district in the environs of Brünn The

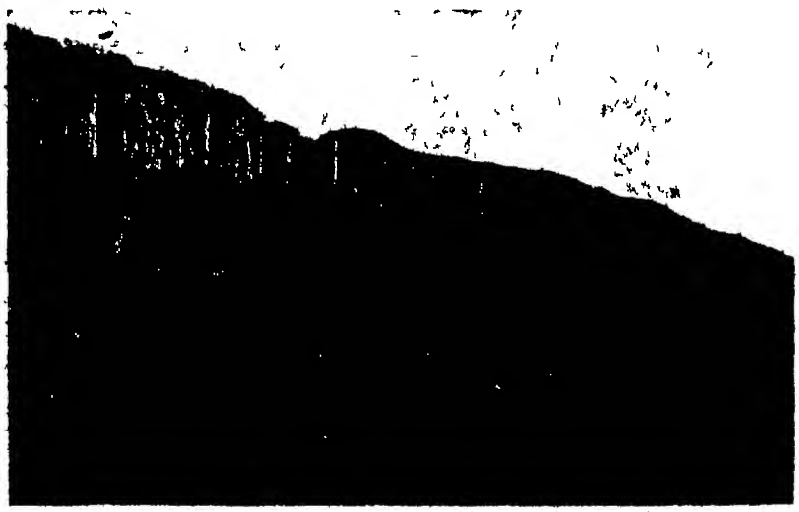


FIG 2 —The wall of the Shonkin Sag, a valley of glacial drainage in Montana

sheet of the geological map described includes part of the ancient Bohemian plateau on the north-west, and part of the Cainozoic foothills of the Carpathians on the south-east The picturesque and varied scenery on the old highway from Hungary to Prague is recalled to us in this lucid memoir Brünn, little visited as it is, should clearly be an exceptional centre for the study of geology The Ortler group furnishes W Hammer (p 174) with material for a discussion of Termier's views on Alpine structure Dr Kossmat (*Jahrbuch der k k Reichsanstalt* 1906, p 274) similarly finds himself involved with Termier and Lugeon in the "Gebiet zwischen dem Karst und dem Zuge der Julischen Alpen" A specialised congress on Alpine structure, with months of field-excursions, would be needed for the answering of all these questions, but even then the new views daily propounded would effectually overwhelm the answers M Vacek (*Verhandlungen*, 1906 p 203) is allowed free scope for a highly controversial paper on the basin of Graz, in which he compares the "green beginner" in geology, who rushes into tectonics, to a stutterer delivering a public speech The name of the specially "green" one is presently shouted across the barriers of this scarcely edifying tourney The geological sections given are, of course, of considerable interest, and show a country rich in transgressions and unconformities Vacek points out the need for considering the isolated masses of Palæozoic and Mesozoic sediments in relation to the geography of the times when they were laid down Thus in many cases they were deposited in gulfs running along the hollows of an ancient crystalline series The author strips away these sediments, and seeks to trace the surface of a central Alpine land-mass denuded in pre Palæozoic times G A J C

OCEANOGRAPHICAL RESEARCH

THE Prince of Monaco presided at the formal opening of the Scottish Oceanographical Laboratory at Edinburgh on the afternoon of Wednesday, January 16 A distinguished gathering of representative naturalists from the leading cities of Scotland took part in the ceremony On the motion of the Lord Provost of Edinburgh, the Prince of Monaco was called upon to take the chair A brief explanatory statement of the genesis and development of the laboratory and of the end aimed at was given by Mr W S Bruce, the leader of the Scottish Antarctic Expedition and the founder and director of the laboratory He showed how Scotland might be regarded as the cradle of oceanography, Edinburgh having been associated with the study of the oceans for a longer period than any other place in the world The gathering together and arrangement of the material had been going on for years, and represented the work of eight scientific expeditions In many respects it was an absolutely unique collection The place it was now in was essentially a workshop for oceanography, and Mr Bruce appealed to the people of Scotland to support this movement to place oceanographical research on a permanent footing There were men able and willing to do the work if once the laboratory were properly established and affiliated to the great teaching institutions of the country

In a short address the Prince of Monaco paid a high tribute to the admirable work which had been accomplished by Mr Bruce and his companions in the Antarctic seas Their expedition had been probably the most fruitful of all the expeditions carried out about the same time and yet by far the most economical Seven other speakers, representing various interests, spoke as to the claims Mr Bruce's new venture had on the people of Scotland Sir William Turner referred to the close connection which the University of Edinburgh had had with the *Challenger* expedition and with later expeditions of a like character Dr Dobbie said that the seals and birds which the Scottish Antarctic Expedition had presented to the Royal Scottish Museum were probably unsurpassed by any like collection in any museum of the kingdom, and that other museums had greatly benefited through the generosity of Mr Bruce Dr Horne, as representing various scientific societies made special reference to the geographical knowledge which had been gained by the staff of the *Scotia*, to the practical sympathy which the Scottish Geographical Society had taken in the expedition and to the generous manner in which the Royal Society of Edinburgh in spite of its straitened means, had undertaken the publication of the memoirs describing the results Prof Arthur Thomson, as representing other Scottish universities directed particular attention to the character of the Oceanographical Laboratory as a place where a man could train himself for oceanographical work Mr Henry Coates of the Perthshire Society of Natural Science commented on the value of the collections in the laboratory being arranged as a regional museum Dr Rottenburg of Glasgow, and Mr Robert M Vitie of Edinburgh expressed their sympathy with a project which seemed to be a natural consequence of the Antarctic Expedition, the success of which had rejoiced the hearts of the many who had been interested in it

The laboratory occupies a low one storied building on the north side of the Surgeons' Hall There are four rooms, the largest of which is filled with cases stored with specimens from the Arctic, while another contains specimens from the Antarctic Each case is devoted to a particular group of animals, crustacea, fishes, molluscs, sea-urchins &c, systematically arranged, with the memoirs and papers describing them placed on the lower shelf One interesting case is arranged bathymetrically, the typical animals of different depths being placed on corresponding shelves In the Antarctic room special cases are devoted to special regions, such as the Weddell Sea Scotia Bay, &c, or to different islands, the South Orkneys, Gough Island the Falklands, and so on One interesting specimen in the collection is a large granite boulder, ice-marked, weighing 3 or 4 cwt, which had been dredged up from a depth of 1775 fathoms in lat 62° 10′ S and long 41° 20′ W The whole collection, Arctic and Antarctic represented the gatherings of the scientific work of five vessels, the *Balaena*, the *Windward*, the *Blencathra*, *Princess Alice II* and the *Scotia* Photographs of these and of interesting scenes during the *Scotia's* voyage decorated the walls At the present time many of the specimens are in the hands of the naturalists who are working up the various groups, while the larger animals are for the most part distributed throughout Scotland in various museums There are many duplicates which should prove useful in effecting exchanges with other similar institutions and so gradually increase the value of the Edinburgh collection

The inauguration of the Scottish Oceanographical Laboratory was the first of a series of public and semi-public functions at which the Prince of Monaco was the leading figure On the evening of January 16 he was the principal guest at the dinner of the Royal Society Club Lord Kelvin presided and Prof Geikie acted as vice-chairman On Thursday, January 17, the Prince received the degree of Doctor of Laws from the University of Edinburgh On the evening of the same day he delivered an address on the exploration of the high atmosphere before the Royal Scottish Geographical Society Prof Geikie, president of the society occupied the chair, and introduced the Prince as one well known as an enthusiastic devoted and successful student of natural science His investigations had been conducted on a scale which had only been rivalled by Government expeditions sent out by great nations For at least twenty-five years he had traversed the ocean in search of knowledge He had established a great oceanographical institute at Monaco, a weather bureau, and a museum, and last year he endowed at Paris an oceanographical institute at a cost of not less than 160,000*l* The president then handed to the Prince the gold medal which the society had awarded him in recognition of his scientific work

In the course of his address, the Prince said that in the last few years the improvements in the manufacture of steel had made it possible to fly kites at great heights carrying self registering apparatus Also the India-rubber industry had enabled balloons carrying self-registering apparatus, to be sent to altitudes hitherto inaccessible Through the liberality of the German Emperor a great establishment had been set up at Lindenberg for the systematic investigation of the upper-air meteorology This was over the land In 1904 the lecturer had become interested in the subject, and he began to make plans for investigating the problem over the sea To reach great heights it was necessary to attach to the line or wire a series of kites at intervals and if no layers of calm air were encountered a very great height could be reached and the kite kept there by the vessel moving with a speed of not less than 7 metres per second There were many difficulties on board ship due to complications of wind distributions in the different layers After a season's work with kites in the Atlantic the Prince resolved to try the *ballons-sondes* The method first adopted was to use two light india-rubber balloons filled with hydrogen The one carried the self-registering apparatus while the other and more inflated balloon was attached to it, and aided the ascent to the required height At this height the upper balloon burst, and the lower balloon with its instruments descended as a parachute, and hovered over the sea so long as the float at the end of the stray line touched the surface of the water This could be seen at a distance of eight or ten miles The bursting of the balloon was somewhat indefinite, and an improvement was subsequently effected by means of which the one balloon was released altogether at the desired height This was done by means of a current from a small dry cell set in action when the pen of the barograph on the lower balloon touched a conductor set at the pressure corresponding to the desired height Also by use of a formula taken in connection with the observed ascent of the system, the line of descent of the "*ballon parachute*" could be approximately calculated, and the ship steered for the place By means of apparatus of this kind pressure and temperature curves had been brought back from a height of 7500 metres in latitude 78° 55 In the high latitudes the experiments had been greatly interfered with by fog The drift of air in still higher regions had been studied by means of pilot balloons, which had been followed through the telescope of a theodolite to heights of nearly 30,000 metres These indicated that in latitude 80° north, at a height of about 13 600 metres, there were at times winds blowing with a velocity of 60 metres per second, or 130 miles per hour The results of several cruises had shown that "if the principal States of the world were willing to diminish a little the expense of international quarrels by submitting them to the judgment of a tribunal less costly than that of war, and if they preserved more resources for the veritable interests of humanity, it would be possible with powerful means very soon to know the laws of meteorology, the key to which seemed to be found in the higher atmospheric regions"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE — The voting on the proposed reform of the mathematical tripos will take place on Friday and Saturday February 1 and 2

The placet executive committee has issued a letter to non resident members of the Senate pointing out that "the proposed scheme is supported by a large majority of the resident members of the Senate, a majority which includes eight heads of houses, more than thirty professors, all the official university teachers of mathematics, and the whole mathematical staff of several of the larger colleges Moreover, the principles of the reform have already been approved by the Senate It is, however, impossible for the reform to be carried into effect unless it is supported by the votes of a large number of non-residents The rejection of the proposed reform would be a great calamity for the future of the Cambridge School of Mathematics Further, the precedent established by the reversal of a decision already made would be a serious menace to the practical working of the government of the University"

THE citizens of Montreal resolved at a meeting on January 16 to raise 200,000*l* for an endowment fund for the McGill University Mr Robert Reford promised to contribute 10,000*l* Lord Grey presided, and Lord Strathcona was also present at the meeting

A COURSE of eight lectures on "Certain Fundamental Problems in Physiology Common to Animals and Plants," to be given at University College, London by Dr W M Bayliss, F R S, commenced on Wednesday, January 23 The lectures are open to all students of the University of London

MR G P DARNELL SMITH has been appointed assistant director of technical education and manual training to the Board of Education, Auckland, New Zealand Mr Darnell Smith has been on the staff of the Merchant Venturers' Technical College, Bristol, since September, 1892, and some time ago he was promoted to the post of assistant professor of chemistry in the college

THE Duke of Northumberland on January 17 opened the new Royal Grammar School at Newcastle-upon-Tyne, which has been built by the governors at a cost of 60,000*l* to take the place of an older building In his inaugural address the Duke of Northumberland said, with regard to recent elementary education, we have probably over-

weighted the coach Small brains have been strained further than they should be, a smattering rather than a real grounding in knowledge, and a "cramming" rather than a forming of character, have been given He hopes that the revival of the interest in secondary education is a sign that we are going to mend our ways in these directions My own belief, he continued, is that the proper form for education to take is to teach very few subjects in the elementary schools and to teach them thoroughly Then, instead of wasting time in making a level of mediocrity, let promising children be taken out of the elementary schools, and, when they are really likely to profit by superior and special instructions, bring them into secondary schools All the population who show that they are able to profit by the advantages of secondary education should receive it Some of the money spent on elementary education might be saved and spent on technical education

PROF SCHUSTER has offered to the University of Manchester during the next three or four years an annual sum of 350*l* as the stipend of a reader in mathematical physics The council and senate have accepted with great gratification Prof Schuster's generous gift, and the post will be instituted forthwith The reader will be attached to the department of physics His primary duty will be the promotion of research in the subject of mathematical physics, but he may also be called upon to give a course of lectures on the subject Prof Schuster in a letter to the Vice-Chancellor, gave his reasons for making his offer, as follows —"I have been watching for some time with considerable apprehension the growing separation between the subjects of mathematical and experimental physics This separation followed perhaps naturally on the rapid growth and exceptional success of the experimental side during the last twenty years, but it cannot, in my opinion, fail to be detrimental to the further progress of the science I have been trying in the physics honours school of our university to give equal weight to the two branches of the subject, and the offer I now make is intended to emphasise the close connection which should exist between experimental and theoretical work I believe that at the present moment the foundation of such a readership as I contemplate would be of advantage to science generally and to our school of physics"

MR E B SARGANT, education adviser to the High Commissioner of South Africa, read a paper at the meeting of the Royal Colonial Institute on January 15 on federal tendencies in education Among other subjects of educational importance, Mr Sargant dealt with movements especially characteristic of higher education, such as the unceasing stream of young men of good circumstances which flows from the various parts of Greater Britain through our ancient universities a movement which, in the case of Oxford, was so powerfully reinforced by the bequest of the late Mr Rhodes From the point of view of our larger national character, it is difficult to put too great a value upon the influence exerted by such a circulation of students through the heart of our higher educational system He then spoke of the need of reproducing this kind of education in the colonies themselves and said that our great public schools and colleges ought to realise that at no distant date they may themselves be asked to extend into Greater Britain Mr Sargant also discussed the federal stimulus in education, of which the London University, in its purely examinational aspect, must be considered to be a first cause, and observed that, from an Imperial point of view, the University of London has centred the thoughts of many of our fellow-subjects in all parts of the British Dominions upon the value of some unity of educational aim, even though it may be only a unity of standard In the discussion which followed, Sir A Rücker pointed out that in any dominion of the Crown it is possible for a candidate to test himself in order to see whether he has attained a standard equal to that which is attained by a good English schoolboy or undergraduate

PROF RUDOLF TOMBO, jun of Columbia University has compiled an interesting set of registration statistics concerning the principal universities of the United States The statistics are published in the issue of *Science* for December 21, 1906 Comparing the figures for 1906 with those of the preceding year, it is seen that California, Leland Stanford, Johns Hopkins, North-Western, and Columbia universities have all suffered a decrease in attendance The greatest gains have been made by Pennsylvania, New York, Indiana, Missouri, Syracuse, Virginia Nebraska, Ohio, Cornell, Illinois, Chicago, and Michigan universities Harvard and Yale with a few other universities have remained stationary in numbers Examining the numbers of students taking different faculties, most of the institutions this year show an increase in enrolment in the arts department This is true, so far as men are concerned, of every institution in the table, with the exception of Johns Hopkins and Wisconsin, though several universities for a number of years have registered continual losses in their arts departments these losses being in many cases due to corresponding gains in the scientific schools Prof Tombo says a reaction has apparently set in in this direction, at least at a number of institutions At Princeton, for example, the number of arts students has increased from 629 to 758 at Yale from 1323 to 1350, at Columbia from 557 to 606 whereas the number of science students at the same institutions has decreased from 624 to 484 in the case of Princeton from 1028 to 929 in the case of Yale, and from 560 to 524 in the case of Columbia At Harvard the discrepancy is even greater The largest gain in the number of science students has been made by Illinois (from 880 to 1020)

THE *Times* recently published some details of the work done by the London County Council Education Committee in the direction of the proper training of children on the physical side With regard to hygiene and medical work, the head teachers of the schools are instructed to give attention to such questions as ventilation the scrubbing of floors, and the inspection of the "offices" Children who come to school dirty are washed or if further purification is needed they are sent home Notification is made to the medical officer when any child attends school suffering from an infectious disease or after coming from an infected home Defective children receive special attention, and lists are made in order that they may be medically inspected The staff of trained medical nurses now numbers thirty two The nurses are constantly at work visiting the schools, where they closely examine the children, confer with the teachers, schedule the unclean and those suffering from skin diseases and generally continue the work of the teachers in these matters The education committee has its own medical officer, an assistant and twenty three other qualified medical men or women, who give a half or a quarter of their time These medical officers if necessary exclude a child from school and recommend the temporary closing of the school itself in case of extensive prevalence of infectious disease In examining the children reported to be defective, if they find that the defect is such as to make it desirable that the child should be remitted to a "special" school, they recommend accordingly The question of bad teeth is not overlooked Much care is devoted to cases of defective sight Care is exercised in seeing that no child's sight is strained and the number of children who visit the hospitals for treatment is very large Physical exercises, including all that modern scientific and practical experience can suggest as best fitted for the pupils, form an important part of the curriculum of every school The exercises are health-giving, and are enjoyed by both boys and girls Games are also encouraged and even organised by the voluntary efforts of the teachers Most schools have their athletic clubs and the Council is now making a new departure by providing playing grounds

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 15, 1906 —"Calcium as an Absorbent of Gases, and its Applications in the production of High Vacua and for Spectroscopic Research" By Frederick **Soddy** Communicated by Prof J Larmor, Sec R S

By means of a special electric furnace surrounded by a porcelain tube and enclosed within a glass tube it has been found possible to heat reagents *in vacuo* in sealed

soft glass apparatus, to a far higher temperature than the softening point of glass Calcium heated in this manner is, under suitable conditions, an absorbent of all the known gases, with the exception of those of the argon group Provided the initial gas-pressure does not exceed a few millimetres of mercury, all the common gases are rapidly and completely absorbed by calcium between 700° C and 800° C, and a vacuum attained through which the electric discharge cannot be forced Arndt (*Ber d d Chem Gesell*, 1904, xxxvii, 4733), in an investigation of the melting point of calcium, noticed that the calcium volatilised freely below its melting point when heated in a vacuum of 1 mm mercury, and the vapour reacted energetically with the oxygen and nitrogen of the residual air, producing a great improvement in the vacuum He did not investigate the behaviour of other gases

This behaviour of calcium is all the more surprising because in ordinary circumstances it shows a great disinclination to react, and may be heated in a tube filled with air at atmospheric pressure to a very high temperature without causing much absorption A low initial pressure of the gas and volatilisation of the metal are essential in using calcium as an absorbent Barium and strontium behave in a manner very analogous to calcium In the case of hydrogen and its compounds, the absorption becomes more complete, and the vacuum improves when the calcium is allowed to cool owing to the hydride possessing an appreciable tension of dissociation at the high temperature

The high vacua readily produced by the absorption of residual gases by calcium are at least equal to the highest attained by any other process By filling the apparatus with mercury after the action of the calcium, and compressing any residual gas several hundred times into a tiny spectrum tube, it was found that the vacuum was still so high that the spectrum tube was of high resistance and fluoresced brightly under the discharge, showing a faint hydrogen spectrum Since argon is not absorbed, the air must be first removed from the apparatus by means of a Fleuss pump and by replacement of the last traces with some argon-free gas, before the calcium is brought into action The condensed gases evolved from the apparatus on heating usually suffice to replace the last of the air during the mechanical exhaustion The calcium, being a good conductor of electricity, may be readily heated to the required temperature within the sealed glass vessel by induction through the walls from an alternating circuit outside the vessel The special feature characterising the new method is the rapid and complete absorption by the calcium of the gases condensed on the walls, and in the electrodes, &c, of the apparatus being exhausted as soon as these are expelled by heating These gases, known technically as "film gases," consist largely of hydrogen and carbon compounds, and cause most of the difficulty experienced in practice for they readily re-condense and introduce a kind of steady vapour pressure within the apparatus, greatly increasing the time required for exhaustion

In the apparatus usually employed for experimental work a porcelain tube with an external screw-thread is wound with a platinum resistance wire through which a current is passed A porcelain test-tube containing the reagent is slipped within this furnace tube, which in turn slips within a wider porcelain tube, which again slips within the external glass tube provided with platinum wires sealed through the glass for conveying the heating current This tube is then sealed to the apparatus to be exhausted

In one form of apparatus for heating the calcium by induction, a calcium disc is bored with central hole through which a short bundle of soft iron wires pass Two porcelain crucible lids bored with central holes fit over the calcium disc, the ends of the iron wires projecting beyond the lids This arrangement is slipped into a glass tube with the axis of the iron core at right angles to the length of the tube A coil of soft iron wire is cut at one point and bobbins of wire slipped over the two ends, which are then brought opposite and close to the ends of the iron core within the glass tube On exciting the bobbins with an alternating current of high periodicity (200 to 400 periods) a current of the order of a kiloampere is induced in the calcium disc, heating it to the required temperature

The phenomena when successive quantities of air are admitted into an apparatus containing heated calcium are of special interest, for all but the 1 per cent of argon is rapidly absorbed, and in this way the minimum quantity of argon necessary to carry the discharge and show a spectrum has been determined Below 1/50 mm argon does not conduct, at this pressure the green and orange lines are faintly visible, at 1/25 mm the reds appear; at 1/2 mm the spectrum tube has a resistance equivalent to an alternative air gap of 5 mm., while at 1 mm. pressure the tube is still brilliantly fluorescent With helium, introduced into the apparatus as a mixture of oxygen with a known small quantity of helium, the tube is non-conducting to the discharge at pressures below 1/20 mm of helium when every trace of other gases is absent In presence of hydrogen or oxygen one-hundredth part of this amount is sufficient to show the D_3 line of the helium spectrum The conclusion is drawn that the inert monatomic gases in the absence of every trace of polyatomic gases show a great disinclination to conduct the discharge, and this accounts for many isolated facts familiar to workers with high vacua The rapid "running out" of spectrum tubes filled with inert gases is due, not to the absorption of these gases, but to the absorption by the electrodes of the traces of hydrogen, &c, always present initially or introduced by the electrodes (compare Skinner, *Phil Mag*, 1906 [vi] 12,481) When this has occurred the pure monatomic gas no longer conducts The fact observed by Lord Blythswood and H S Allen (*Phil Mag*, 1905 [vi] 10,497), that an X-ray bulb may be readily exhausted from atmospheric pressure of air to a "vacuum so good that the tube had to be heated to allow the discharge to pass through it," by the use of charcoal cooled in liquid air according to the method of Sir James Dewar, at first seems inconsistent with the fact that seventeen parts per million of the air, consisting of helium and neon, remain unabsorbed, and the residual pressure must therefore be about 1/75 mm The explanation is to be found again in the disinclination of these monatomic gases to conduct when pure For this reason the electric discharge test of the goodness of a vacuum is altogether misleading, for with the inert monatomic gases pressures within the range of the mercury barometer appear to be high vacua The great power of calcium in absorbing every trace of carbon dioxide, hydrogen, water vapour, hydrocarbons, &c, derived from impurities in the apparatus, and from the lubricating grease of stop-cocks, makes it a powerful aid to the methods of spectroscopic research

Appendix—"Results of Gauging High Vacua by the Evaporation Test" By A J **Berry**.

The degree of high vacua produced by different processes may be gauged by the rate of evaporation of liquid air in a Dewar vessel exhausted by the process The same globular vessel of about 1 litre capacity, silvered internally, was exhausted (1) by the mercury pump, (2) by the use of cooled charcoal from atmospheric pressure, using two successive quantities of charcoal, (3) by cooled charcoal after the air had been first removed by a mechanical pump It was to be expected from the conclusion drawn in the preceding paper that the degree of vacuum obtained in the second test would be much inferior, tested by the evaporation method, to that obtained in the third The expectation was fully borne out by the experiments The liquid air evaporated at the rate of 898 grams in four days in the vessel exhausted by the second method, which was rather faster than in the first method, when the vacuum was produced by a mercury pump The vacuum produced by the third method was far better, 942 grams evaporating in six days, and only 610 grams in four days

December 6, 1906—"The Theory of Photographic Processes Part iii The Latent Image and its Destruction" By S. E **Sheppard** and C E. K **Mees.** Communicated by Sir William Ramsay, K C B, F R S

The authors consider that "developability" is brought about by the acceleration of reduction by preliminary treatment The essential chemical reaction in development is

$$Ag + R'' \rightleftharpoons Ag|met| + R',$$

which normally proceeds to a state of equilibrium If now to this state of equilibrium any cause tending to lower

the metastable limit of the silver solution be introduced, then the halide becomes developable. The following substances can act as germs for a dry plate:—(a) silver, introduced as colloidal silver and then converted to the metallic state, (b) gold, (c) platinum, (d) silver sulphide, (e) gas ions from flame gases.

All evidence tends to the conclusion that a necessary and sufficient condition for "developability" is the production in the silver-halide grain of a new substance. The authors have accepted a chemical theory of the latent image chiefly on account of the way in which the latent image gives certain definite chemical reactions, and especially on account of the destruction of the latent image by oxidising agents. They have made an extended investigation of the destruction of the latent image by chromic acid, with especial reference to the theory of primary and secondary development put forward by Mr. Sterry in January, 1904. This theory suggests that the primary image formed by the development of the "latent" image is intensified by silver transferred from other parts of the film.

The authors found that exposed plates, dipped in chromic acid solution before development, have their γ_∞ and inertia unaltered, but the development-velocity constant, K, lowered by the action of the chromic acid adsorbed to the silver bromide. This chromic acid was destroyed by sodium sulphite, and the plates then gave a normal K. If, however, a plate was left after chromating, before development a fall in γ_∞ was found which could not be destroyed by sulphiting, and which therefore showed an absolute destruction of the latent image. Probably this action was a re-oxidation process.

The second part dealt with a peculiar action of salts of copper, iron, mercury, and uranium, which desensitise the plate, so that enormous exposures are required to produce normal results. If the plates are exposed and developed after desensitising, K and γ_∞ are found to be normal. If, however, the plates are left for a long period after exposing, then the desensitisers destroy the latent image by lowering γ_∞ in the same way as chromic acid.

The theory advanced for this action was that desensitisers act by catalysing the oxidation reaction, which is the opposite to the ordinary light reduction action, and this view was supported by experiments which showed that with copper, quinine salts, and with iron oxalates restored the lost sensitiveness, a result analogous to that obtained for the negative catalysis of quinine in the case of the catalysis of sodium sulphite oxidation by copper salts.

The authors have also repeated the experiments of Abney and Englisch upon the failure of the Bunsen-Roscoe reciprocity law, and of the integration of intermittent exposures. The results obtained agree with those previously found. The authors consider ripening to be due to the joint action of the (a) formation of resonating systems, (b) formation of reduction product, the function of the gelatin being to form resonators and to assist in reduction.

The authors consider the formation of the latent image to be connected with the photoelectric effect, and to be due to the liberation of electrons which ionise the halide and the surrounding gas. This theory accounts for the action of dyes as sensitisers for their own region of absorption, since these electrons will ionise the halide effectually. Ionisation leads to chemical reduction, resulting in the formation of a subhalide in solid solution.

PARIS.

Academy of Sciences, January 14.—M. A. Chauveau in the chair.—A comparison between chemical phenomena determined by a heating resulting from external calorific causes and those due to a heating produced by electrical actions: M. **Berthelot.** Stress is laid on the fact that changes undergone by a substance when heated by passage of an electric current cannot be entirely regarded as due to the thermal effect of the current.—The so-called artificial plants: Gaston **Bonnier.** An adverse criticism of a recent paper of M. Stéphane Leduc.—The eighth campaign of the *Princess Alice II*: The **Prince of Monaco.** A general account of the work done on Spitsbergen in the fields of geography, hydrography, meteorology, oceanography, zoology, and physiology.—The critical points of inverse functions: A. **Hurwitz.**—The critical points of a class of functions: Georges **Rémoundos.**—The potentials of an attracting volume the density of which satisfies Laplace's equation: Tommaso **Boggio.**—The movement of liquids with high velocity through very large conduits: H. **Mercszyng.** Experiments on pipes of 38 cm. and 50 cm. diameter, the water flowing at rates between 3 and 4 metres per second, gave results differing markedly from those obtained by an extrapolation from Darcy's formula. Experiments were also made on the quantities of sand carried in suspension by the water at different velocities.—The importance of the thickening of the anterior edge of the wing of the bird in flight: application to aeroplanes: E. **Seux.**—A new wireless telemechanical apparatus: G. **Gabet.**—The exact calculation of the molecular weights of gases: Daniel **Berthelot.** A comparison of the results of the application of two methods of reduction of experimentally determined gas densities to the determination of the molecular weights of hydrogen, nitrogen, carbon, and chlorine in terms of oxygen = 32.—A sulphate of chromium the acid of which is entirely hidden, and on the equilibrium of chromic solutions: Albert **Colson.** The salt, the method of preparing which is described, has the composition $Cr_2(SO_4)_3+6H_2O$. The solution of the salt reacts with barium chloride very slowly.—Dyeing and ionisation: Léo **Vignon.**—The action of silicon chloride upon chromium: Em. **Vigouroux.** These two substances react at about 1200° C., Cr_2Si_3 being formed. The properties of this silicide have already been described by MM. P. Lebeau and Figueras.—A new silicide of manganese described by M. Gin: Paul **Lebeau.** The author gives reasons to suppose that the silicide of manganese recently described as new by M. Gin is in reality impure SiMn.—A continuous apparatus for the preparation of pure oxygen for use in organic analyses: A. **Seyewetz** and M. **Poizat.** Acid solution of potassium permanganate is allowed to flow into hydrogen peroxide solution. The advantages of ease of control and purity of the gas are claimed.—The study of a case of isomerism in the oxonium combinations of Grignard and Baeyer: W. **Tschelinzeff.** An attempt to discriminate between the two formulæ suggested by Baeyer and Grignard respectively for the addition compounds of magnesium alkyl compounds and ether. Thermochemical experiments led to indecisive results, but the action of water on the substances obtained in different ways tends to support Baeyer's views.—Methyl ethylketone peroxide: M. **Pastureau.** Details of the preparation, properties, and reactions of methylethylketone peroxide.—The acyclic unsaturated and β-chlorethyl ketones. A method of synthesis of the 4-alkylquinolines: E. E. **Blaise** and M. **Maire.**—A method of destroying larvæ in plantations of trees: M. **Eberhardt.** A solution of formol, glycerol, and water is used, and details are given of the mode of application in different cases. The treatment has given excellent results in trees already attacked by larvæ.—A new antelope from the valley of Ituri, *Cephalophus ituriensis*: Maurice **de Rothschild** and Henri **Neuville.**—The Liriopsidæ, crustacean isopods parasites of the Rhizocephalæ: Maurice **Caullery.**—A precaution to be taken in the observation of colours: E. P. **Fortin.** If a coloured object is subject to a constant illumination, the colour seems to differ according as the eye is or is not exposed to light. The precautions necessary on this account are indicated in the cases of coloured chemical reactions, in meteorological observations, and in the examination of paintings.—The Aptian, Gault, and Cenomanian, and on the general characters of the Lower and Middle Cretacian in the Atlas of eastern Morocco: W. **Kilian** and Louis **Gentil.**—The relations between the Tertiary strata and volcanic rocks in Anglona (Sardinia): M. **Deprat.**—The Calabrian earthquake of September 8, 1905: G. **Mercalli.**

NEW SOUTH WALES.

Linnean Society, November 28, 1906.—Mr. T. Steel, president, in the chair.—Recent travels among the aborigines of the north coast of Australia between Broome on the north-west, and the Gulf of Carpentaria and at Melville Island, for the purpose of ethnological and anthropological

study Prof **Klaatsch**. The aborigines of the northern half of the continent are more numerous than is generally supposed, and their number may be estimated as between 100 000 and 150,000 An appeal was made by the lecturer, on behalf of the northern blacks, for greater consideration in the way of a more adequate provision of reserves, and for more effective protection than the southern blacks have received in the past Apart altogether from humanitarian questions the demand for their more enlightened treatment is justifiable on scientific grounds alone —Contribution to a knowledge of the flora of Australia, part v R T **Baker** Two additions to the flora are described—*Acacia fuliginea*, an ally of *A ixiophylla*, Benth, *A viscidula*, A Cunn, and *A dictyophleba*, F v M (section Plurinerves), from the Rylstone district, New South Wales, and *Callitris Morrisoni*, an unrecorded pine from West Australia, with fruits not unlike those of *C Drummondii*, and branchlets which would pass muster for those of *C robusta*, R Br An analysis of the oil of *Eucalyptus Rudderi* Baker and Smith, is given, together with other economic notes on this species New localities or an extended range for a number of species are recorded —New Australian species of the family Æschnidæ (Neuroptera Odonata) R J **Tillyard** The species herein added to the Australian list form about as miscellaneous and remarkable a set of insects as it would be possible to find and serve to show the composite character of the Australian Odonate fauna They comprise an East Indian species, a Chilian species (*Petalia apollo*, Selys [♀], of the subfamily Cordulegasterinæ, determined by Dr Ris, of Belgium) and three species described as new, of which one is referable to an Indian genus, and two are probably the types of new genera —Notes from the Botanic Gardens, Sydney, No 12 J H **Maiden** and E **Betche** The following species are described as new —*Boronia Deanei*, in swamps between Clarence and the Wolgan, Blue Mountains a handsome species nearest to *B parviflora*, Sm, *B repanda*, formerly recorded as *B ledifolia*, J Gay, var *repanda* F v M, *Toechima dasyrrhache*, a sapindaceous plant from Tintenbar, published on behalf of Prof Radlkofer and at his request, *Acacia accola* from the borders of New South Wales and Queensland, nearest allied to *A neriifolia*, A Cunn, and *Rottboellia truncata* an aberrant species from Yandama, north-west New South Wales New varieties are also described, and new records for New South Wales - Revision of Australian Lepidoptera III Dr A J **Turner** This instalment comprises supplementary notes on families previously treated of namely, the Syntomidæ the Notodontidæ, and the Geometridæ Three genera and thirty-one species are described as new

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DIARY OF SOCIETIES.

THURSDAY, JANUARY 24

ROYAL SOCIETY, at 4 30 — Experiments on the Dark Space in Vacuum Tubes Sir William Crookes, F R S —On a New Iron Carbonyl, and on the Action of Light and of Heat on the Iron Carbonyls Sir James Dewar F R S and Dr H O Jones - On Regeneration of Bone, Part II Sir William Macewen F R S —Note on the Application of Van der Waals's Equation to Solutions The Earl of Berkeley —On the Presence of Europium in Stars Joseph Lunt

ROYAL INSTITUTION at 3 —Recent Advances in the Exploration of the Atmosphere Dr W N Shaw, F R S

SOCIETY OF ARTS at 4 30 —The Bhils of Western India Captain E Barnes

INSTITUTION OF ELECTRICAL ENGINEERS at 8 – Investigations on Light Standards and the Present Condition of the High Voltage Glow Lamp C C Paterson

FRIDAY JANUARY 25

PHYSICAL SOCIETY, at 5 The Strength and Behaviour of Brittle Materials under Combined Stress W A Scoble —A Spectrophotometer F Twyman —Photographs of Electric Sparks K J Tarrant

INSTITUTION OF CIVIL ENGINEERS at 8 —Alternating Current Commutator Motors C A Ablett

SATURDAY JANUARY 26

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford) at 6 30.—Occurrence of the Sea Bream (*Pagellus centrodontus*) in Essex Waters Dr James Murie —The Evolutionary History of Carts and Waggons Thomas W Reader

MONDAY, JANUARY 28

ROYAL GEOGRAPHICAL SOCIETY at, 8 30.—A Journey through Central Asia to Northern China Major C. D Bruce.

SOCIETY OF ARTS, at 8 —Gold Mining and Gold Production: Prof J W. Gregory, F R S

LONDON INSTITUTION at 5.—The Transmutation of Elements: Sir William Ramsay, K C B, F R S.

INSTITUTE OF ACTUARIES, at 5.—Further Notes on some Legal Aspects of Life Assurance Practice A. R Barrand

TUESDAY, JANUARY 29

ROYAL INSTITUTION at 3 —Survivals from the Past in the Plant World Prof A C Seward, F R S

MINERALOGICAL SOCIETY, at 8.—Experiments bearing on the Order of Crystallisation of Rock constituents Prof H A Miers, F R.S —Isomorphism as illustrated by Certain Varieties of Magnetite Prof. B J Harrington —Serpentine rock from the Taruthaler Köpfe, Tyrol Dr A P Young —A Simple Tabular Arrangement of the Thirty two Crystallographic Classes Dr J W Evans

FARADAY SOCIETY, at 8.—*Discussion on Osmotic Pressure* —Apparatus for the Direct Measurement of Osmotic Pressure Earl of Berkeley — Indirect Methods of Measuring Osmotic Pressure W C. Dampier Whetham, F R S —Osmotic Pressure from the Standpoint of the Kinetic Theory Dr T Martin Lowry

WEDNESDAY, JANUARY 30.

SOCIETY OF ARTS, at 8 —Apprenticeship J Parsons

SOCIOLOGICAL SOCIETY, at 8 —Swiss Referendum as Instrument of Democracy J A Hobson

THURSDAY, JANUARY 31

ROYAL SOCIETY, at 4 30 —*Probable Papers* On the Two Spectra of the Elements as Evidence of the Composite Nature of the Atoms Prof W N Hartley, F R S —On the Explosion of Pure Electrolytic Gas Prof H B Dixon F R S, and L. Bradshaw —On the Firing of Electrolytic Gas by a Compression Wave L. Bradshaw —A Recording Calorimeter for Explosions Prof B Hopkinson —On the Discharge of Negative Electricity from Hot Calcium Dr F Horton

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures Major Percy A Macmahon, F R S

FRIDAY FEBRUARY 1

ROYAL INSTITUTION, at 9.—The Methods of Combating the Bacteria of Disease in the Interior of the Organism Sir Almroth E. Wright, F R S

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THURSDAY, JANUARY 31, 1907

THE PLANT AS MACHINE

Plant Response as a Means of Physiological Investigation. By Prof Jagadis Chunder Bose Pp xxxviii+781, with 278 illustrations. (London: Longmans, Green and Co, 1906)

THE emotions that will be aroused by this book in different classes of readers may well be very dissimilar A biologically equipped reader with no special knowledge of plant physiology will experience dazzled admiration for the logical, progressive way in which the author builds up, not in words, but actually experiment on experiment, a complete functioning plant from three simple conceptions These conceptions, which will be critically considered later, are briefly the following —*stimulation*, the transference of external energy to the plant, *contraction*, the constant "direct response" of plant-cells to stimulation, *expansion, including growth*, the "indirect response" to stimulation

This present book, big as it is, is devoted almost entirely to the mechanical responses of plants, another volume is promised on electrical responses By mechanical responses we are to understand all movements, in the widest sense, not only the obvious movements of sensitive and sleeping plants with all geotropic and heliotropic movements, but also the movements of expansion in growth and the pumping of water up the plant, and, further, "death-spasms" and all the minute shrinkages of unspecialised cells produced by stimulation All these vital manifestations are dealt with in sequence, passing from the simple to the complex, and in them the author finds nothing that cannot be interpreted in terms of his three primary conceptions

Another type of reader, a student of plant physiology, who has some acquaintance with the main classical ideas of his subject, will feel at first extreme bewilderment as he peruses this book It proceeds so smoothly and logically, and yet it does not start from any place in the existing *corpus* of knowledge, and never attaches itself to it with any firm adherence This effect of detachment is heightened by the complete absence of precise references to the work of other investigators The student, puzzled by the number of original conceptions, may hesitate between accepting and rejecting the whole book, and will probably wait, with judgment suspended, until someone with more conventional ideas of the plant than Dr Bose has re-investigated the phenomena and interpretations here brought forward

The extreme isolation of this book is no doubt to be explained by the author's scientific past Dr Bose is, we believe, a physicist originally, and has been drawn into biology by following up the similarities which he has announced between the electrical and other responses to stimulation given by metal bars and by living animal or vegetable cells (see "Response in the Living and Non-Living," 1902) Dr Bose preaches the continuity of response in all matter, living or non-living, in metal wires, muscle fibres, sensitive plants, and vegetable cells in general, and has described effects in metals corresponding to fatigue, latent period, summation of stimuli, temperature-optima, and other characteristic vital phenomena. From this similarity of the effects of stimulation he passes to assuming a similarity of mechanism in all these cases In metal bars the mechanism is, of course, physical, and there is no question of stored chemical potential energy liberated on stimulation this purely physical interpretation is by him extended to living cells, molecular change of protoplasm, not chemical change, is all he recognises, and when a temporary storing of energy has to be admitted he considers it a purely physical accomplishment

The originality of this and of other fundamental views stated or implied in this book makes it more important for a reviewer to consider these conceptions critically than to give an outline sketch of the whole book, interesting and stimulating though it is

Dr Bose conceives the living organism as a delicate responding physical machine the responsive movements of which are brought about entirely by external stimuli All external stimuli, chemical, thermal, mechanical, photic &c, produce the same *direct response*, namely, contraction of the cells with active expulsion of water, a negative turgidity-variation, and a negative electrical variation

These effects are observable, not only in so-called "sensitive" plants, but in all living parts of plants, and it is a definite advance, due to Dr Bose's delicate experimentation, to have it shown that all radial organs, stems, styles, stamens, &c, shorten on stimulation

In addition to the direct response of contraction there is also an opposite effect, the so-called indirect response of expansion, which is produced at a distance from the stimulus by the water expelled in contraction causing distension or expansion of cells elsewhere, with accompanying positive turgidity-variation and positive electrical variation Of this nature, an indirect effect of stimulation merely, is the characteristic vital phenomenon, growth

Much, then, is made to depend upon stimulation, yet the author holds the astonishing view that all the work done by the plant is the real equivalent of energy received by the impact of stimuli from without The author does not even attempt to impart verisimilitude to this view by including food materials among his stimuli For him the living organism is not a combustion engine doing work by the energy liberated chemically in oxidising carbon compounds, but it is just such a physical machine as a windmill, requiring blows rather than food to make it work and the last picture in the book is indeed a figure of this windmill We fear that, valiant and thorough as Don Quixote in his attack upon this misconceived phenomenon, the author hardly avoids a similar fate by starting with an inverse misconception

It is easy to see that Dr Bose acquired this view of stimulation originally from his experiments on the

responses given by metal bars In these experiments the work done on the bar, generally by torsion, greatly exceeded the output of energy in the electrical and other response produced There is no liberation of stored potential energy in such a case, therefore there is really no similarity with the mechanism of the living cell, though molecular change no doubt occurs in the protoplasm as it does in the metal wire

Just as we hold that Dr Bose has transferred from his physical experiments a conception of biological stimulation which is inadmissible for either animal or vegetable cells, so it seems to us that his conception of contraction is derived only from the activity of animal muscles, and is inadmissible for the mechanical response of plant cells There is really no evidence that these two phenomena are of quite the same order and both due to active contraction of the living part of the cell, though an *a priori* philosophical outlook has led many to assume it

When the irritable stamens of Centaurea are touched they shorten, even to one-third of their length, which diminution is accompanied by an extrusion of a corresponding amount of cell sap from the cells into the intercellular spaces, and by comparative flaccidity of the cells

Now the vegetable cell, unlike the muscle cell, is at its maximum rigidity when at rest, being distended by the osmotic force of molecules dissolved in its sap These molecules are kept in by the protoplasmic lining of the cell, which is impermeable by them though freely permeable by water The tenacious and elastic cell-wall, itself freely permeable to everything, is able, owing to its tenacity to protect the protoplasm from being ruptured by the osmotic pressure, which reaches several atmospheres

Whether one holds the view that the shrinkage which occurs on stimulation has, as its antecedent stage, decomposition of some of the osmotic molecules or sudden permeability of the protoplasm, the contraction itself cannot be attributed to active contraction of the living part, but must be due to the forceful elastic contractile recovery of the dead cell-wall, now no longer distended through osmotic force It is incredible that the stimulated protoplasm, so watery in texture, can contract actively against an extending force of several atmospheres and actively expel cell-sap Unlike muscle, the "contracted" plant cell is flaccid and the protoplast does its mechanical work while recovering from contraction, in again extending its wall ready to react to fresh stimulation This corresponds to the relaxation time of a muscle, so that the two machines are quite different in their phases

Further, another fundamental difference lies in this, that a muscle does not really contract in volume when stimulated, it merely alters its shape, becoming shorter and broader, a special property exhibited by a number of non-living peculiarly organised structures, india-rubber strips, for example The plant cell, on the contrary, really contracts in volume, whether it alters its shape depends upon the relative extensibility of the different walls Again, this contractility of plant cells is inherent in the very organisation of the cell, and is found in all primitive types, and in all young cells, and is not a specially evolved mechanism like the contracting muscle fibre It is finally interesting to note that it has not been really proved that heat production is associated with the contraction of plant cells rather than with the subsequent expansion when work has to be done by the protoplast

Dr Bose's conception of growth is more elusive and still more isolated Growth, the indirect remote response to stimulation, is due to that part of the energy of a stimulus not used in direct response This energy is held to be communicated hydraulically to the growing point as pulsations, and of these pulsations graphic records are given. Stimuli applied directly to the growing region must, of course, cause contraction, *i e* retardation of growth, as their direct response, therefore the pulsations of the growing point are attributed, as indirect responses, mainly to excitatory reactions occurring below the zone of growth

Dr Bose's book abounds in experimental evidence on all points, a feature of the greatest merit, yet we must say that many of the fundamental experiments are not nearly critical enough For example, one reads continually of the striking effect of *thermal* stimuli these are produced by the electric heating of a platinum-wire-frame which surrounds the living stem, when a succession of stimuli is wanted it is produced by passing and cutting off the current alternately In relation to this treatment we are given no idea of the temperature that the wire or the plant attains, or of how far the temperature of the plant actually oscillates under this alternately hot and cold environment The effects produced in this way are very extraordinary—longitudinal contraction of stems, styles, and other radial organs, stimulation of *Mimosa* pulvini, &c —but there is no attempt to trace the transition from such effects to those of surrounding high temperatures which are kept uniform

The reader rather distrusts the author's views on thermal effects on finding him propose seriously to examine (chapter xliv) the effect upon growing parts of "thermal radiation" apart from the effect of the actual temperature of the part This distinction is surely confusion of thought, and the differences recorded are no doubt due to actual difference of temperature, for the method of experiment is quite fallacious It is, indeed, supposed that a plant surrounded with a hot radiating platinum spiral, the whole being enclosed in an experimental chamber, will be at the same temperature when there is a heat-proof screen between the plant and the radiating spiral and when this is removed, and this just because a thermometer somewhere in the general air of the chamber keeps a uniform constant temperature all the time!

The apparatus and the experimental methods employed show great ingenuity and a praiseworthy simple directness of attack which, however, occasionally passes into *naïveté* One feels that valuable results are to be got with the delicate optical lever, the kunchangraph, the balanced crescograph, the

morograph, &c., instruments which measure changes of one-hundredth of an inch or less, though their very delicacy must introduce sources of error, about which nothing is to be found in the book. Workers on growth will be forced to abandon their primitive and clumsy methods, and much good will result from the refinements here introduced

In conclusion, we can only say that there are literally scores of special points of the greatest interest raised in the course of this book, which cannot, of course, be dealt with here If the primary desire that these points raise is the desire to cross-examine, it is to cross-examine, not the author, but the plant itself which bears such uniform and honestly-intentioned testimony in favour of Dr Bose's views All such experimental cross-examination will make for the progress of knowledge, and we think that Dr Bose can claim that his book will be an external stimulus (if not in his sense at least in ours) to the growth of plant physiology and the responses of future investigators

F F BLACKMAN

THE NORSEMEN IN THE ORKNEYS

Monumenta Orcadica The Norsemen in the Orkneys and the Monuments they have left By L Dietrichson With original drawings and some chapters on St Magnus Cathedral, Kirkwall, by Johan Meyer Pp xiv+200 (Kristiania, London Williams and Norgate, 1906) Price 3l net

THIS handsome quarto volume from the pen of the learned head of the Art Museum of Christiania is issued in a bi-lingual form, being divided into two parts, the first is an abridgment in English of the second, which is in Norwegian It appears at an opportune time, when the ties connecting the two kingdoms are closer than they have ever been since the separation of the islands with which it deals from the Scandinavian kingdom on the marriage of the daughter of Christian I to the Scottish king in 1469

Based chiefly upon the importance of the Orkney Islands to Norway as a basis in the Middle Ages, and on the historical interest attaching to the architectural remains of the centuries during which they were ruled from that country, the author's task has been a scientific inquiry into every detail connected therewith He displays throughout a most intimate knowledge, not only of the Sagas, but of the writings of those authors on both sides of the German Ocean who have essayed to identify the sites and fix the questions of the dates and details of construction of the more important erections, and during a visit to the islands half a dozen years ago, when he was accompanied by Mr Myers, he had an opportunity of personal inspection of the remains, and has produced a work that will be heartily welcomed by all students of the archæology, history, and architecture of our northern isles.

The introduction deals with the Orkneys and their connection with Norway, and with the Orkneys in literature, in which the author, after enumerating all the islands and parishes with their Norse derivatives, adjusts a few of them according to his own researches, describes their scenery, climate, and natural history, and gives a list of many Norse words surviving in the names of homesteads and in the dialect, the Roman, Norse, and Scottish authors whose writings have constituted the sources of the history of the islands are also briefly referred to In order to present the work as a continuous whole, the author has included the pre- and post-Norwegian periods, and divided it into three books, dealing respectively with the prehistoric, the Norwegian, and the Scottish remains He is in full accord with all other Norse scholars in repudiating the idea of a Scandinavian origin for the sepulchral chambers, stone circles, standing stones, and brochs which abound all over the islands, these he briefly describes, without, however, committing himself to any of the various theories that have been urged regarding them, and relegates them all to a period anterior to A D. 600

From that period to A D 872 is assigned to an early Celtic Christian occupancy, that of the Peti and Papæ The distinguishing architectural features of their chapels are pointed out, six existing ruins are enumerated, while from saintly dedications and Saga records the sites of eight additional ones that have disappeared have been identified

The Norse period 872 to 1468 is the most important and interesting portion of the work, there is already a large amount of literature dealing with this period, and to those who have been nurtured on the contributions of Munch, Dryden, Anderson and others there may be much of detail to unlearn by those who accept the author's views At the same time, the older works suffer nothing by the comparison, in fact, any faithful interpretation or correlation of facts, both historical and monumental, could hardly have been looked for until after the publication of the Rolls edition of the Icelandic Sagas in 1887 Prof Dietrichson opens it with a wave of emigration from Norway to the island of Sanday where he supposes the first stronghold of the earls to have been established The monuments are chronologically arranged, the first group comprises the remains assigned by the author up to the end of the tenth century, and embraces the tumuli bearing the names of the Saga characters who are recorded as having met their death in the Orkneys and as far south as the Oykell in Sutherland the Norse burial mounds being distinguished from the Celtic "cairns" by their having been constructed, not of stones, but of earth "barrows," as well as a few churches and the Norse earls' palace as Birsay

With the eleventh century the interest increases, among the more important items which are new may be mentioned the confirmation of the opinion that the Thing-stead was held in Rendall, in opposition to the popular belief that it was at Stenness The question of the time of the erection of the unique St Magnus Church on Egilshay, which has been a puzzle to antiquaries for a long time, has been focussed for various assigned reasons into the three years immediately following the murder of the earl on that island, that is, 1135–8

Ecclesiologists who have been searching for the

missing monastery recorded by Fordun as existing in the Orkneys, and for which sites have been claimed in Helliarholm and Stromness, will be interested to know that the hitherto disregarded buildings in the immediate vicinity of the chapel on Eynhallow are recognised by the author as part and parcel of one whole establishment, which he is satisfied is none other than the Cistercian monastery presided over by Laurentius until he was transferred to Melrose in 1175

Coming to speak of the cathedral of St Magnus, "the grandest building in the Orkneys, next to Trondhjem Cathedral the mightiest monument of the whole of ancient Norway," he looks upon it as the living embodiment of the idea that when the warlike spirit of the Vikings sank to rest their intellectual strength and civilising power came into play Mr Myers contributes chapters on the architecture and the architectural history of the cathedral, also a comparison with buildings of the same period elsewhere On entering the building he is appalled by the vulgarity that dominates the whole of the modern decoration, especially the painted wooden screen, the hideous galleries, and the walled-up triforium, and appeals to the noble Scot by picture and pen to remove the disturbing additions and regain the grand effect of an unbroken interior

These chapters will be read with great interest, the more so as a recent large legacy is available for the repair and restoration of the building They are given in full in both languages characterised by strong individuality in the method of treatment, and exhibit a wider range of professional knowledge of the subject than has hitherto been displayed in its investigation, entering minutely into details of construction and ornamentation, as well as interpreting the thoughts of the various builders to whom he has assigned the different additions and alterations He introduces many ideas that will be new even to those most familiar with the building and who have given it much consideration The result of his comparison with Durham, Southwell, Dunfermline, the late lamented Selby and some others leads him to conclude that the artistic tendencies which produced the original structure issued mainly from the north of England, probably Durham, and spread not only to Orkney, but to the west of Norway. Passing on to other buildings of the Norwegian period, the author traces from the existing ruins of the bishop's palace at Kirkwall the form and subdivisions of the original structure, describes the more modern additions, and mentions several points on which his conclusions differ from those of former writers He says of the palace —

"There is no building in the Orkney Isles that is more revered by us Norwegians than the palace in which our greatest king died "

A short account of the Norse earls' palace at Birsay and Notland Castle in Westray ends the Norse period.

The Scottish division treats of the Stuarts' palaces at Birsay and Kirkwall, and of the style of building in town and country, in which Norse characteristics blend more or less with the now almost all-prevailing Scottish style

The five appendices to the volume comprise a lengthy Orkney chronology; lists of Orkney earls and bishops, the island names mentioned in the Sagas, Fordun, and other authors, down to the most recent chart in a carefully tabulated form, and a table of the genealogy of the Orkney earls The work is profusely and beautifully illustrated, chiefly by original drawings executed by Mr Myers The cover bears the arms of Kirkwall emblazoned on it. The book is one of the most valuable contributions to the historical literature of our islands, if not the most, that has appeared since the time that Barry first published his "History"

J W CURSITER

ORGANIC CHEMISTRY FOR STUDENTS

Cours de Chimie organique By Fréd. Swarts Pp 669 (Paris A Hermann, 1906)

ACCORDING to the preface, this book is intended for medical, engineering, pharmaceutical, and other students who, having attended lectures in organic chemistry, desire to increase their knowledge of the subject without expending the time necessary for a more advanced course It is founded on the author's lectures delivered to students commencing the study of organic chemistry at the University of Ghent To these lectures Prof Swarts has added, as far as possible, the descriptive material which he considers necessary for the study of elementary organic chemistry, as also the discussion of the theoretical points omitted from the lectures in consequence of lack of time The distribution of these theoretical discussions throughout the text is preferred to their collection in an introduction, as giving the student an opportunity of first becoming acquainted with the substances concerned, only the more typical of which are specially described

Such a book is admirably planned to assist the student who has had the stipulated preliminary training in realising the close connection which exists between the experimental facts and the theories of organic chemistry It is, therefore, all the more to be regretted that, after opening the introduction with a few historical remarks, the author has inserted a number of short sections on such subjects as isomerism, metamerism, polymerism, tautomerism, multiple linkings, and stereoisomerism In any case these are subjects which are bound to be referred to in the descriptive text This, in fact, happens, stereoisomerism, for example, being discussed in a far more satisfactory manner with the crotonic acids and with fumaric and maleic acid

These matters are followed in the introduction by the usual few pages devoted to an account of qualitative and quantitative elementary organic analysis It seems to the present writer that however useful such pages may be in the ordinary text-book on organic chemistry, in a book which lays special stress on the theoretical as opposed to the descriptive side

of the subject it would have been better to omit these and to have utilised the space so saved in filling up some of the gaps left in the theoretical treatment, and to which we refer later. The same remarks apply to some extent to the sections on the separation of organic compounds, which are valuable in so far as they treat of the law of partition and the distillation of mixtures of miscible and of non-miscible liquids, but much space is taken up by descriptions of working methods unnecessary to the student who has attended an experimental course in the subject, and insufficient for the instruction of the inexperienced. Again, in a book of limited space, why lavish two whole pages on illustrations of a large table carrying a small combustion furnace, with tube and fittings, and of an ordinary type of reflux apparatus! The book could hardly have suffered from the omission of these, together with most of the remaining illustrations, the instructional value of which, for example, of the sketch of the superseded distilling tube of Le Bel and Henninger, or of the large acetylene burner on p 95, is not always apparent

Having found fault so far with the introduction, and that chiefly because of its failure to reach the standard of excellence set up by the preface, we must state that the theoretical discussions throughout the remainder of the book are clear and satisfactory, as are also the later portions of the introduction dealing with the calculation of formulæ and molecular weights, the thermochemistry of carbon and the general properties and classification of the compounds of carbon according to their structure

Of the 585 pages remaining after the introduction, 317 are devoted to the consideration of the alicyclic compounds and thirty-nine to the cyclic groups intermediate between these and benzene This, with its derivatives, is described in 175 pages, leaving only fifty-four for the discussion of the heterocyclic compounds, the glucosides, the albuminous substances, and the soluble ferments As the book contains comparatively little small print and the margins are ample, it follows that some of the groups must be treated in but a scanty manner, if at all, those included under the three last headings being the chief sufferers from this cause Certainly in the space at his disposal the author gives a surprisingly comprehensive review of the more important of the heterocyclic compounds

The arrangement of the alicyclic compounds differs in several respects from that to which we are accustomed The esters appear under the old name of "compound ethers" amongst the ethereal derivatives of the alcohols, whilst we do not make acquaintance with the ketones or the aldehydes until after the description of the monocarboxylic acids and the substances derived from these A few helpful tables are given showing the principal mono- and di-basic acids with their main physical properties, and of the aldoses with the corresponding penta-hydroxy-acids The carbohydrates are followed by a succinct account of the derivatives of carbonic acid

In the course of the chapters on the alicyclic compounds, optical activity and the hypothesis of the asymmetric carbon atom, the dynamics of esterification, the nature and properties of the pseudo-acids, the constitution of the complicated derivatives of cyanogen, and the employment of the inversion of cane sugar in the measurement of the strength of acids, are clearly if briefly explained Similar concise discussions of the question of the structure of the benzene nucleus—including the arguments in favour of the centric formula, the application of Thiele's hypothesis of partial valencies, and the bearing of the optical properties—and of the constitution of the diazonium salts and the diazotates and their relation to the nitrosamines are to be found in the chapters on the aromatic compounds We must remark at the same time that there is no mention of several important matters, such as the difficulty of esterifying certain carboxylic acids by boiling with alcohol and an acid, and Victor Meyer's explanation of this on the assumption of the so-called "space interference," nor can we find any account of Gustav Komppa's synthesis of r-camphoric acid

References to the original literature are of great value in all beyond the most elementary text-books, and would have been specially so in a work intended for the use of students otherwise unguided, here such references are entirely wanting Only occasionally even does the description of a reaction, a synthesis, or a theory suggest its author's name

The book is provided with a subject index but not with a table of contents, fortunately, the page-headings are well arranged Although some portions of the book are decidedly disappointing, on the whole it can hardly fail, if conscientiously read, to broaden the views even of students considerably beyond an elementary stage of knowledge in organic chemistry

G. Y

SOME OPINIONS ON TEACHING MECHANICS

The Teaching of Elementary Mechanics Discussion which took place at Johannesburg at the British Association Meeting in South Africa on August 29, 1905, in Section A, Prof Forsyth, President of the Section, in the Chair, together with written criticisms and a paper by C E Ashford, M A Edited by John Perry Pp 74 (London Macmillan and Co, Ltd, 1906) Price 2s net

THIS little book is another addition to many outcomes of Prof Perry's never-failing activity and energy in trying to improve the teaching of our schools in matters connected with elementary science At the British Association in Johannesburg last year Prof Perry, in the midst of his arduous duties as general treasurer of the association, found time to open a discussion on the teaching of elementary mechanics, and, not content with this, he collected the remarks of all the speakers at the meeting and specially engaged a "chiel takin' notes" to keep a record of their speeches He next wrote round to a large number of teachers and others in England,

and if he only received eleven replies it cannot be denied that the writers of these replies fairly represented all sorts and conditions of men, and that the subject has been discussed, (1) in its academic aspect, (2) from the point of view of the experienced schoolmaster, and (3) from the standpoint of the engineer The book contains a reprint of the recommendations of the Committee of the Mathematical Association on the Teaching of Elementary Mechanics

What conclusions can the average reader infer from the divergent opinions expressed in this book?

(1) There is a general consensus of opinion that the teaching of mechanics should be more experimental and less dogmatic

(2) Prof Perry condemns the use of costly and complicated laboratory apparatus, and considers that more can be learnt from a cheap screw jack and a rusty old pulley than from costly Atwood's machines In this he is perfectly right

(3) If the teaching of mechanics is to be made more practical, greater attention should be paid to friction and other resistances which occur in nature So long as friction is shelved into the background, mechanics cannot be anything but the study of what would happen under impossible conditions

(4) The advocates of the poundal and the advocates of the slug will never agree

(5) The academic side does not wish the poundal adopted for practical purposes (p 13) In examination papers answers are never—well hardly ever—asked for in poundals, and generally a candidate would lose marks by giving the pull of a railway engine in poundals or tonals But the academic teacher strongly objects to swallowing the slug, and not without reason

(6) The engineering side is trying hard to force the slug down the throat of the academic teacher, its main plan of campaign consisting in attacking the poundal as unit of force

(7) Both sides seem willing, up to a certain point, to allow beginners to solve elementary problems by the use of Newton's laws, according to which change of motion is proportional—not equal to the impressed force - a method which avoids both the poundal and the slug But they still cling tenaciously to the modern substitute for Newton's statements

(8) The engineering side has had to accept the C G S dynamical units and there seems no reason why schoolboys should not leave the equation $F=ma$ until they learn to work with the metric system

(9) The universal adoption of the metric system affords the most probable direction for a compromise

(10) Prof Perry advocates (p 61) teaching mechanics through force rather than through mass as the *fundamental notion*, and yet some remarks seem rather to indicate that he wishes *every schoolboy* to realise that force is the vector time flux of momentum

(11) Many teachers condemn tonals, velos and celos, others strongly advocate them One critic (p 55) goes so far as to express regret "that for units of momentum and mass-acceleration we have no suitable names at all", but does not the *poundal* meet his requirements when regarded as the unit of *mass-acceleration?* Surely it is the use of this unit for measuring *forces* (by naval engineers and others) that is open to the serious objections raised on p 64

(12) The same differences exist in regard to centrifugal force

We have no wish to reopen controversies on these questions, but we cannot help thinking that if every schoolboy is to know the laws of motion, it is also important that every schoolboy should know a great deal about the laws of the country he lives in He should also learn something about economics, something about choice and chance, in order that he may not develop into a gambler, some experimental and geometrical optics, and many other things besides, which he does not now learn That "it must be good for all boys to learn something of measurement and how to use their hands" is a point on which all can agree with Prof Perry G H B

OUR BOOK SHELF

What Are We? By Leonard Joseph Pp xiii+394 (London Kegan Paul, Trench, Trübner and Co., Ltd, 1906) Price 15s net

"THEY say the owl was a baker's daughter Lord, we know what we are, but know not what we may be" A certain incoherence in Ophelia's words would have prevented us at one time from regarding her as a possible authority on the metaphysical questions raised by the title to this book, but she is soundness, suggestiveness, and lucidity themselves when compared with Mr Joseph

Three peculiarities in this pretentious work will strike the observant reader —(1) Excellent as "Chambers's Encyclopædia" and the paper called *Answers* are in their own place—and Prof York Powell is said to have thought highly of the latter—we doubt if there are many scientific works of the first rank in this country in which these are paraded in the foot-notes or in the list of books consulted (2) Mr Joseph poses in the opening paragraphs as an orthodox believer whose motto is "Search the Scriptures, watch and pray," but confesses in the end, with much pride, that this is merely a device to secure for his pages a reading from unreasonable and stubborn church-goers It would have been more tactful to assume that all his readers were reasonable human beings, or that, at any rate, the weight of the arguments adduced would of itself overcome all initial distrust (3) Mr Joseph argues soberly—if the term sober can be applied without contempt to one who apparently abhors total abstainers as amongst the most depraved of men—for sexual promiscuity This is bad, indeed, it is even worse than the unsound physiology that defaces the last page, or than the wealth of padding which surrounds and encompasses what might have received adequate treatment in a sixpenny pamphlet

The Human Mechanism, its Physiology and Hygiene and the Sanitation of its Surroundings By Prof. Theodore Hough and Prof W T Sedgwick Pp ix+564 (Boston and London Ginn and Co, 1906) Price 8s 6d

MANY writers of text-books on physiology for the lay public are quite incompetent to act as teachers of their fellow men, because they are unacquainted with the

science they profess to write about, or imagine that a description of the bones and a few other anatomical facts constitutes physiology so far as the general public are concerned. There are, of course, some books which are notable exceptions to this rule, but we never remember to have seen one before which so admirably fits the purpose for which it is written as the little treatise before us, which the authors have labelled "The Human Mechanism."

A little anatomy has, of course, to be introduced, but this is kept in the background; what comes to the front is the study of function; this is well up to date, and the first half of the book is a clear and succinct account of modern physiological knowledge. It avoids unnecessary details, but omits nothing essential. It is so lucidly written that the wayfaring man will have to be a terrible fool if he does not understand it.

From such a sure bed rock, the authors pass on in the second part of the book to the application of physiological laws, and treat of personal, domestic, and public hygiene in turn. We can award to this part no higher praise than to say that it is as excellent as the preliminary physiological portion. It teems with sound practical common sense; it points out convincingly, avoiding too great technicality, the scientific reason for their faith. If the people at large and their rulers could be induced to act on its precepts preventive medicine would indeed make a great stride in the battle man is always waging against disease and the consequences of his misdeeds.

Arithmétique graphique. Introduction à l'Étude des Fonctions arithmétiques. By G. Arnoux. Pp. xx+226. (Paris: Gauthier-Villars, 1906.) Price 7.50 francs.

Assisted by M. Laisant, the author has put into an interesting and occasionally novel form the elementary theory of congruences, indices, and residues of powers. He has also given various examples of the use of Galois's imaginary units, and of the solution of cubic congruences by means of Cardan's formula. There is nothing essentially new in the book, but it is entertaining as the work of an amateur who has looked at the subject in an independent way, and has occasionally put the facts into an unusually vivid form, for instance, when he gives a chess-board diagram showing the solutions of $x^2+y^2 \equiv 2$ (mod 5), and so on.

Familiar Trees. By Prof. G. S. Boulger. Pp. vi+160. (London: Cassell and Company, Ltd., n.d.) Price 6s.

As the author informs us in his preface, the book is an endeavour to describe the beauties of our familiar trees. He further points out that "Their many associations have interests that appeal to the historian and the moralist, to the student of literature and of folk-lore, but little less than to those interested in botany." . . . "The time has gone by when we could be content to stand agape at the wonders and beauties of the world of Nature; we require now some attempt, at least, at an analysis of the origin, purpose and significance of the objects of our admiration." Mr. Boulger has certainly given a fairly interesting account of a few of the commoner trees and shrubs. In his introduction he defines trees as perennial plants with a principal stem of some considerable diameter, rising from the ground and forming wood. Their woodiness distinguishes them from all herbs, and their one principal stem from shrubs. In spite of this, however, he includes in his book of familiar trees shrubs and even climbers, while such familiar trees as the oak, beech, and the lime are omitted and the Scots pine dismissed with a passing reference.

The author has, however, brought together a considerable amount of interesting material concerning the species with which he deals, and the value of the book is greatly enhanced by the many beautiful coloured plates and photographs. The appearance of the cross-section of the wood of the various species is well illustrated by selections from Mr. J. A. Weale's unique collection, and these, like the other plates and figures, do great credit to the artists by whom they were produced.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radium and Geology.

After reading Arrhenius's vivid account[1] of the bombardment of the earth by electrically charged solar dust, one is prepared to appreciate Prof. Joly's hypothesis as set forth in his letter in NATURE of January 24. On the other hand, Mr. Strutt's analysis of granite affords strong support to the view that the radium it contains is of terrestrial origin. The concentration of this constituent in the biotite might conceivably be due to the absorption of percolating water containing radium in solution, but not in the zircon, a mineral which is as impermeable as quartz. A mineral analysis of Cornish granite from Penrhyn made by Miss Davies in our geological laboratory gave the following results:—orthoclase, 24.62 per cent.; albite, 13.42 per cent.; quartz, 40.23 per cent.; muscovite, 10.05 per cent.; biotite, 11.46 per cent.; magnetite and zircon, 0.16 per cent. The heavy portion of the Cornish granite analysed by Mr. Strutt which was insoluble in hydrochloric acid, consisted of silica hydrate and zircon, and if the latter mineral was present to the extent of 0.16 per cent. only, it must have contained, judging from the analysis, 0.637×10^{-12} gram of radium per gram, or a little less than was found in crystals of zircon from North Carolina. In the consolidation of granite the zircon crystallises out first, then the biotite, next the muscovite, afterwards the albite, and finally the orthoclase and quartz; but the concentration of radium diminishes in a similar order, a correspondence that can hardly be the effect of chance.

In the formation of granite, water has undoubtedly played a large part, and may have had a good deal to do with its differentiation from the parent magma. Water forms one of the constituents of biotite, sometimes to the extent of 10 per cent. Thus it is possible that the richness of granite in radium is due to the removal of this constituent in solution from the general mass of a magma and its concentration in certain portions which were converted by hydration into granite.

But if this be true of granite, may it not be true as well of basalt and other basic rocks in which also water plays its part, though to a less extent? All the igneous rocks to which we have access are very superficial parts of the earth's crust, and it is unsafe to reason from them to the deeper underlying regions. There may be other causes, apart from solution, by which electrically charged atoms like those of disintegrating radium have found their way up from below to enrich the outermost layers of our planet. In any case, the assumption that radium is uniformly distributed through a crust forty-seven miles in thickness seems to require support from independent evidence, and until that is forthcoming it is equally open to us to assume a thick crust, 800 miles, consisting of silicates with radium distributed through it according to some unknown law, but with a rapid increase towards the zone affected by highly heated waters.

January 26. W. J. SOLLAS.

1 Arrhenius, "Lehrbuch der kosmischen Physik," 1903, p. 149 (Leipzig.)

The Mathematical Tripos.

In NATURE of January 17 (p 273) there is a long article by Prof Perry which contains a one-sided account of the new regulations for the mathematical tripos So far as I can see, no new arguments are suggested, for every statement has been already fully discussed and as, I believe, thoroughly answered To repeat all these at length would take too much space and time, but perhaps the Editor of NATURE will allow me to remark on two or three assertions which can be answered in a few words

Prof Perry speaks of those who vote "non-placet" as the opponents of reform, yet these "non placets" have continually urged the necessity of reform It is only this particular reform that they object to It was proposed in the Senate House (*Reporter*, p 325) to have joint meetings of the two parties and to agree on some common action It has also been suggested that we might use the Smith's prizes to separate the different kinds of students It is, therefore, *the "placets' whom we ought to designate as the opponents of reform* when they refuse even to consider such proposals So also in the circular (December, 1906) issued by our committee, we say that in the event of the regulations being rejected, we are ready to cooperate in promoting such measures as would, while preserving the best features of the present system, at the same time remedy its admitted defects

In another place Prof Perry tells us that one of the most important regulations is that a student may take part i in his second term He gives no explanation why this regulation has been objected to yet this makes all the difference If students can pass part I in first-class honours in their second term, the subjects cannot be much more than schoolboy knowledge, and do not deserve Cambridge first-class mathematical honours These subjects are fewer in number than those of the existing part i Others have been curtailed for example, the *uses* of the binomial, exponential, and logarithmic theorems, and also those of Taylor and Maclaurin are required, but *without their proofs* Is a tripos *which does not include these proofs worthy of first-class university honours in mathematics?* It is a new thing that a mathematician should learn theorems *by rote* without understanding the reasons

In regard to the higher studies, there is only space to notice that the existing part ii has been generally regarded as a complete failure, yet its theory and practice are to be retained in the new programme

The proposed scheme was signed by fifteen only out of the twenty-five members of the Mathematical Board, the remainder not voting Among *college lecturers in mathematics*, our count makes the majority opposed to the scheme, and the same is true of *resident graduates* in *mathematical honours* Almost all the training for part i is now done by the lecturers and teachers in the various colleges It is only with these that the mathematical undergraduate is brought into close contact, and it is to them rather than to the professors (who necessarily confine their lectures to the highest subjects) that we should look for guidance on the needs of their pupils (see the "non placet" circular)

The name of a distinguished mathematician is claimed as a supporter by Prof Perry The name of Lord Kelvin here comes naturally to our remembrance, as he is our greatest natural philosopher If the mention of the first name is an argument, how much more that of Kelvin? Yet Lord Kelvin is opposed to the new "so-called" reformation His opinion of the university training has been given to us in his fly-sheet Other old members have also explained the good they derived from their "old-fashioned" Cambridge course

Prof Perry states that if the "non-placets" should succeed in reversing the decision of the Senate, they are establishing a precedent which cannot conduce to the smooth working of the University He must have forgotten the precedent set in 1872–3 when a proposal making Greek non-compulsory in the *previous* was carried in 1872, only to be rejected when it came up again a few months later in 1873 No constitutional difficulties appear to have followed It was proposed in the Senate House by one at least of the supporters of the scheme that if the October decision is reversed they should *repeat the voting term after term* until the opposite side was wearied out Is it considered that such a course will conduce to the smooth working of the University? So strange a plan appears to be void of all argument, and if even partially adopted will throw the whole Senate into confusion.

There are many points in Prof Perry's summary of the regulations which would require an answer if they had not already been so fully replied to. I hope I have shown that some of his statements, at least, require verification

EDWARD J. ROUTH.

Fertilisation of Flowers by Insects.

DR ALFRED RUSSEL WALLACE, in an article entitled Creation by Law," contributed to the *Quarterly Journal of Science* in October, 1867, alluded to a Madagascar orchis (*Angraecum sesquipedale*) with a nectary varying in length from 10 inches to 14 inches, and prophesied that a hawk-moth will be discovered with a tongue of equal length to fertilise it "That such a moth exists in Madagascar may be safely predicted, and naturalists who visit that island should search for it with as much confidence as astronomers searched for the planet Neptune—and they will be equally successful!" Will someone kindly tell me if this prophecy was fulfilled; if so, when, and the name of the moth?

E W SWANTON

Dr Jonathan Hutchinson's Educational Museum, Haslemere, Surrey, January 17

In reply to Mr Swanton's letter, I have not heard of any moth from Madagascar with an exceptionally long proboscis I think, however I did hear of one from East Africa with a proboscis nearly the length required, but as entomologists do not usually open out and measure the length of proboscis of all the large Sphingidæ they receive some of the required length may exist unnoticed in our public or private collections An inquiry at the insect departments of the Natural History Museum and also of that of the Jardin des Plantes would perhaps afford Mr Swanton the required information

ALFRED R WALLACE

The Immortality of the Protozoa

In a footnote to p 42 of Coleridge's "Biographia Literaria" (Bohn's Library) occurs the following statement —

"There is a sort of minim immortal among the *animalcula infusoria* which has not naturally either birth or death absolute beginning or absolute end for at a certain period a small point appears on its back, which deepens or lengthens until the creature divides in two, and the same process is repeated in each of the halves now become integral"

As I understand (for I am no biologist myself), the theory of the immortality of the protozoa was, according to the generally accepted view, first definitely formulated by Weismann in his lecture "Ueber die Dauer des Lebens" in 1881 It had been indicated before, but never definitely stated But an examination of the passage quoted above with the context in which it occurs (which is too long to be inserted here), shows that already in 1815 Coleridge could allude to this conception as one the truth of which was already accepted among biologists For Coleridge is not stating the fact for its own sake he introduces it merely as an illustration of a fact of etymology Moreover, it is not merely to the phenomenon of multiplication by fission that he alludes, but to the conception to which (at some period subsequent to its discovery) it gave birth

Coleridge took a keen interest in biology, and was, no doubt widely read in biological literature It is possible indeed, that his statement is based, not on anything that he had read, but on what he had heard in conversation with men of science of his day It would be interesting however, to know if the conception had been definitely put forward in writing at this time, and I should be much obliged if you would give me through the medium of your columns, an opportunity of clearing the question up

J. SHAWCROSS

28 Oberstein Road, New Wandsworth, S W, January 19

Perception of Relief by Monocular Vision

A STRIKING example showing how any large lens can "see" in relief (see NATURE, January 3, p. 224) may be demonstrated to an audience

An electric glow-lamp is lit in an optical lantern, and the image of the filament projected on to a screen This image is only sharp in parts

A card with a small hole in it (1/8 inch) is now placed close in front of the lens, this sharpens the image on the screen.

The card should now be moved backwards and forwards, the image *changes* in a remarkable way with every movement, showing that the lens sees the filament from a different point of view from each point of its surface

Photographs taken with the "stop" at either side of the lens make a good stereoscopic pair.

A E. SMITH

8 Farringdon Avenue, E C, January 19

THE RUWENZORI BOUNDARY DISPUTE

THE dispute which has arisen as to the ownership of the Ruwenzori Mountains between the British and the Congo State Governments is the latest example of the danger of a fixed and definite boundary agreement based on unfixed and most indefinite geographical data So long as an elementary knowledge of geography—especially of the conditions and methods which govern geographical map making—forms no part of the educational equipment of our political staff we shall have these unscientific and clumsy disputes which may easily cost the country as much as a small war

In this instance the agreement indicated, as the boundary between the Congo State and Uganda, "a frontier following the 30th meridian east of Greenwich up to its intersection by the watershed between the Nile and the Congo, &c" Presumably some sort of a map was consulted, but in 1894, when that agreement was drawn up no map could have existed which could claim to be more than approximately accurate in respect to any position fixed relatively to the meridian of Greenwich, and in the absence of detailed topography it must have been impossible to foretell whether the demarcation of such a line was even practicable For a political boundary to be of any value it must either be carried by some well-marked natural feature or pass through country where artificial demarcation is possible Consequently, of all dangerous boundary definitions that which involves a straight line through unmapped regions is perhaps the most unsafe It might be urged that in the absence of all topography it was necessary *faute de mieux* to make use of an hypothetical line In that case, treating all existing maps as a blank (which would have been the safest course), it was only necessary to express a doubt as to the finality of the arrangement whilst drafting the agreement.

In the present instance probably no one will be much the worse for an unscientific boundary muddle A certain nervous anxiety to avoid international complications has led to our hasty abandonment of a strip of country which lies between what is now determined as the thirtieth meridian east of Greenwich and that line which was supposed to represent it when the agreement was made The strip is about twenty-five miles in width, and the Congo officials have already taken possession and forbidden the entry of any white men unless engaged on scientific investigation It may be a valuable strip for rubber production or it may not. Whatever it is, it has practically been given away (like many another more important field of international frontier dispute) for the want of a little scientific knowledge of the limitations of geographical definition.

THE ART OF THE LAPIDARY.[1]

BOOKS dealing with precious stones which have made their appearance in the past may be divided into three classes First, works of exact science written by competent mineralogists, like the well-known treatises of Church, Max Bauer, and Kunz, secondly, treatises of an antiquarian character, of which the well-known works of C. W King are the most conspicuous examples, and thirdly, books written from the commercial standpoint, like those of Messrs. Streeter and Emmanuel All these classes of books treat, it is true, more or less incidentally of the lapidary's art, but the information on the subject is often second-hand and sometimes not very trustworthy

It may be readily understood that a skilful lapidary, who is constantly handling different gems from the most varied localities, must acquire an eye- and hand-knowledge of the objects of his craft of a very special kind, and the opinions of such men, based as they are on the results of constant observation and experience, may often be worthy of the attention of men of science A book written by a practical lapidary may thus be expected to have a peculiar interest of its own—one of a totally different character from that which attaches to the kinds which we have enumerated above, and thus it comes about that the work before us constitutes almost a new departure in the literature of precious stones

FIG. 1—Diamond Cleaving From 'The Gem Cutter's Craft

It is only fair to the author to point out that—while justly insisting on the importance and value of the practical knowledge of gems gained by constantly handling them and by noticing their

[1] "The Gem Cutter's Craft" By Leopold Claremont Pp xv+296 (London George Bell and Sons, 1906.) Price 15s net

behaviour on the lapidary's wheel—he fully recognises the great importance of the exact and quantitative methods of the mineralogist. The chapters dealing with the scientific methods for identification of precious stones are, on the whole, fairly complete and accurate, though evidently the information is to a great extent second-hand and sometimes wanting in precision. We notice that the suggestion of the cadmium borotungstate as furnishing a dense liquid for the separation of gems is ascribed to Prof. Church, and not to W. Klein, while the recommendation of the use of the mixed silver and thallium nitrates is accompanied by no hint of the limitations to the use of this substance imposed by its high price and tendency to change colour. The Abbe refractometer is described as a means of determining refractive indices, with no suggestion as to the existence of simpler and cheaper instruments, like those of Prof. Bertrand and Mr. Herbert Smith. The use of the Röntgen rays in differentiating between the various gems and paste is described, but no reference is made to the valuable and exact observations published by Prof. Doelter on this subject. In the same way antiquarian subjects, like the classical and biblical names applied to gems, are dealt with in a very perfunctory manner, the uninstructed reader being left in ignorance as to the wide differences of opinion which exist as to the identification of the particular substances referred to by ancient authors.

It is when the author comes to deal with the practical work of gem-cutting that we feel that he is on safer ground, and his account of the method of cutting and polishing both diamonds and the softer precious stones, fully illustrated as it is, has all the completeness which we might expect from one practically engaged in the industry.

The ordinary methods of "soldering" diamonds into cones of metal (consisting of two portions of lead to one of tin), and grinding and polishing facets by pressing them against a rapidly revolving wheel armed with diamond dust, are well known. Perhaps less familiar to most persons is the series of operations—known as "slitting," "cleaving," and "bruting"—by which diamonds are made to assume approximately the required shape, before the formation of the series of facets by means of the polishing wheel ("skeif"). Diamonds are sometimes sawn across by means of the ordinary lapidary's wheel, a thin iron disc the edge of which is armed with diamond dust, but on account of the equal hardness of the dust and the stone the work is very slow and laborious. Much more frequently the form of the gem is modified by "cleaving," advantage being skilfully taken of the natural octahedral parting-planes of the diamond. The method adopted is that familiar to mineralogists, and is illustrated in the accompanying diagram, Fig. 1.

"The diamond to be cleaved is cemented upon the end of a wooden stick or holder in such a position that the plane of cleavage to be used in the operation lies parallel to the length of the stick, which is firmly fixed into the centre of a weight projecting from the wooden bench in front of the operator. A steel blade is held against the diamond in the desired position and by means of a smart blow upon the back of it, the stone is caused to divide along the cleavage plane."

FIG. 2.—Diamond Bruting. From 'The Gem Cutter's Craft.'

The process called "bruting" demands equal delicacy and firmness of hand, aided by a skill which can only be attained by long practice.

"The bruting of diamonds consists of rubbing two diamonds together in such a way that by continual friction each can be made to assume the required shape. Each diamond is cemented upon the end of a stick or holder about a foot long, and the operator firmly holds one end of each stick in either hand. The stones are then rubbed and pressed one against another over a wooden trough containing a very fine metal sieve, into which fall the particles of diamond dust rubbed from the stones. In order to obtain sufficient leverage the holders which support the diamonds are held against little metal projections on either side of the trough." (Fig. 2.)

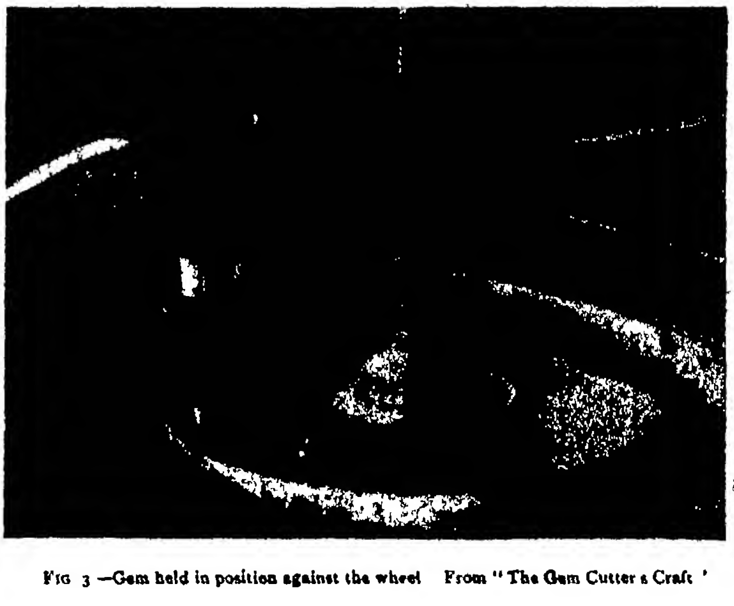

FIG. 3.—Gem held in position against the wheel. From "The Gem Cutter's Craft."

In reading the work before us the mineralogist recognises the fact that a skilled lapidary with powers of acute observation may detect phenomena that could scarcely reveal themselves in any other circumstances. Among these may be noticed the statement

that diamonds that have been cut by the lapidary's wheel lack some of the brilliancy found in gems that have been simply cleaved It appears, too, that the diamonds of different districts differ to a very marked extent in their degree of hardness; the diamonds of New South Wales, indeed, are so much harder than those from other districts that they can only be cut and polished with their own powder

Rubies, sapphires, emeralds, and other coloured stones are of less hardness than diamonds, and their cutting and polishing can be effected by means of diamond dust, carborundum, corundum, or emery But in the case of these softer gems great delicacy of touch, rather heavy pressure and friction are required for their successful facetting The gems to be polished are cemented on the end of a holder made of hard wood about the size of a short penholder, and are cut and polished by being held against metal discs ("laps") supplied with the abrasive and polishing powders (Fig 3)

The latter portion of the book, which deals with the nature, localities, and treatment of the various kinds of gem-stones, presents few features of interest as compared with other works of the kind On some points, as, for example, in the remarks on the artificial production of precious stones the information given is neither very complete nor very exact, but even in this part of the work there are occasional observations which are of considerable interest to the mineralogist

J W J

NOTES

At the moment of going to press we learn with the deepest regret of the sudden death of Sir Michael Foster

The fourteenth International Congress for Hygiene and Demography will be held at Berlin on September 23–29 All papers and particulars referring to the congress may be obtained from the general secretary, Berlin 9 W Eichhornstr 9

Herr F I Beyer, the founder of the world famed colour factory at Chemnitz fifty years ago, died at San Remo on January 2 at the age of eighty-two years The direction of the factory has for some time now been in the hands of his son-in-law, Herr Th Korner

The organisations committee of the sixth International Congress held at Rome finds itself with a balance of about 20,000 francs This sum of money it is proposed to divide into honoraria of 1000 francs each, to be given to young Italian chemists to enable them to be present at the next International congress, to be held in London in 1909

A Reuter message from Brussels reports that at a meeting held on January 29 at the residence of M Beernaert, Minister of State, it was decided in principle to organise a new Belgian South Polar Expedition A scientific committee will determine the programme The meeting appeared to be in favour of the scheme of oceanographic research submitted to the Mons Congress by M Arctowski

At the recent annual meeting of the Royal Microscopical Society, the following officers were elected for the ensuing year —President, Lord Avebury, vice-presidents, Mr Conrad Beck, Mr A N Disney, Dr J W H Eyre Dr Dukinfield H Scott, treasurer, Mr Wynne E Baxter, secretaries, Rev Dr W H Dallinger and Dr R G Hebb

At the annual meeting of the Entomological Society on January 23 it was announced that the following officers had been elected for the session 1907–8 —President, Mr C O Waterhouse, treasurer, Mr A H Jones, secretaries, Mr H Rowland-Brown and Commander J J Walker, R N The outgoing president, Mr F Merrifield delivered an address in which he discussed some of the causes of the persistent abundance or scarcity, generally or locally, of species and varieties of insects, and the relative importance of the consumption of their food and the attacks of their enemies Reference was made to striking characters that seem of no biological importance, to habits and activities not directly concerned with nutrition or reproduction, and the manner in which they are affected by external conditions and to structure and fixed habits indicating their ancestral history and affecting their present capabilities

Prof M I Konowaloff, professor of chemistry in, and at one time director of, the Polytechnikum in Kiev, died in his forty-ninth year as the result of an accident on December 24, 1906 After passing through the physico-mathematical faculty of the Moscow University he became first an assistant and then a docent of chemistry in the same university, in 1896 he was appointed professor of inorganic chemistry at the Petrowskoje-Rasumowskoje Agricultural Academy near Moscow leaving there in 1899 for the new polytechnic at Kiev in the building and equipment of which he had taken an active interest In 1902 he was elected director, but owing to a number of unpleasantnesses having arisen he resigned in 1904 His most important scientific investigations dealt with the composition of the Caucasian petroleums, the nitration of various organic compounds, preparations of aldehydes and ketones, syntheses of aluminium haloids and their isomers, refractivity of nitrogenous organic compounds, nitrogen compounds of the terpene group and the methane series &c, the similarity between the iron salts of organic acids and the nitro compounds In addition to having displayed great scientific activity Prof Konowaloff was always a strong advocate of public lectures especially for the working classes

An Association for the Promotion of Flight is in course of formation The association will aim at assisting inventors and investigators to carry out experiments in artificial flight In order to secure that no funds shall be subscribed by speculators with any hope of return, it is proposed that in the case of its ultimate success in its object, the valuable assets such as a facility for constructing practicable flight machines, should be handed, free of cost, to the nation A provisional committee has been appointed, which includes the Hon C A Parsons, F R S, Sir William Crookes, F R S Major B F S Baden-Powell, and others Major Baden-Powell who is the president of the Aeronautical Society, in a letter to the *Times* explains how the new association differs from the Aeronautical Society and the Aero Club He points out that the newly-formed association has for its main object the acquisition of a fund to be devoted to the purpose already explained The intention is to make a public appeal, and it has been considered that this could be done better by an independent body than by the existing society It is, however, clearly understood that the association shall work in entire accord, not only with the Aeronautical Society, but also with the Aero Club

The birds of Irene near Pretoria, by Mr I E Taylor illustrated by a plate of the eggs and nest of the black duck, and notes on a collection from N E Rhodesia by Messrs W E Stoehr and W L Sclater form the sub

ject of the two chief original articles in the Journal of the South African Ornithologists' Union for December last.

In the fourth volume (pp 173–192) of *Marine Investigations, South Africa*, Dr W. G Ridewood describes a new species of the hemichordate genus Cephalodiscus, obtained from a considerable depth in the Cape seas The new form brings up the number of known species to seven

The report of the Felsted School Scientific Society for 1906 is illustrated with reproductions of photographs taken by the members of that body The most interesting of these represents a nest, with eggs, of a moorhen, built, on some sticks in the river Pett, about 3 feet from the bank, with the base of the structure touching the water The society appears to be in a thriving condition

The Hon Walter Rothschild has just presented to the British Museum (Natural History) a fine mounted specimen of a male Alaskan elk, or moose (*Alces machlis gigas*), which has been temporarily placed in the central hall behind the African elephant The Alaskan elk, we may remind our readers is the largest representative of its species, although some of the estimates of its height are almost certainly exaggerated

We have received the report of the museum committee for the County Borough of Warrington for the past year It appears that Warrington was the first town in the United Kingdom to establish (in 1848) a rate supported public library and a tablet with an inscription to that effect has recently been placed in the building The excavation of the site of the Roman station at Wilderspool has, for the present, been brought to a conclusion and the spoils are in process of being arranged for exhibition

The fourth part of vol iii of the Transactions of the Hull Scientific and Field Naturalists' Club contains a coloured plate of the four known British laid eggs of Pallas's sand-grouse These constitute two complete clutches, both taken on the high wolds near Beverley in 1888, one on June 15 and the other on July 5 The only other known instance of this species breeding in the British Isles rests on the evidence of a young bird found in Morayshire The eggs are the property of Mr I Audas

Under the title of "Nature Names in America," Mr. Spencer Trotter, in the January number of the *Popular Science Monthly*, gives some interesting information with regard to the origin of the vernacular designations of many of the animals and plants of the United States Raccoon, opossum, skunk, chipmunk, and moose are, it appears, taken direct from the Algonquin language Miss I P Bush contributes a translation of a valuable article by Mr Anton Handlirsch, of the Vienna Museum, on fossil insects and the development of the class Insecta

Many naturalists will remember that after the fresh-water jelly-fish Limnocodium was discovered in 1880 and its little polyp stage also described, a very similar polyp, the *Microhydra ryderi*, was found in a back-water of the Delaware River, near Philadelphia, in the United States In 1897 the veteran naturalist Mr Edward Potts, of Philadelphia, described in the *American Naturalist*, without illustrative figures, the production of a medusa or jelly-fish by this little Microhydra The observation escaped the notice of most zoologists, and it is therefore a matter of congratulation that Prof Ray Lankester has obtained from Mr Potts a full description of the budding of Microhydra and of the medusa produced by it, accompanied by numerous excellent drawings These are published in the December (1906) number of the *Quarterly Journal of Microscopical Science* Figures are given for comparison of the medusa and polyp (Limnocodium) from Regent's Park (1880), and of the medusa of Lake Tanganyika (Limnocnida) described in 1893. Mr Potts sent a preserved specimen of the North American fresh-water medusa to Prof Lankester, who submitted it for examination to Mr. E T Browne, well known as a specialist on the medusæ, and a report and figures by him are published together with Mr Potts's memoir. The medusa of Microhydra differs greatly from that of Limnocodium, although the polyp form has many curious points of resemblance in the two genera Only very young liberated medusæ of Microhydra have, as yet, been observed There is obviously an opportunity for further study of a very interesting kind in regard to this last discovery made by Mr Edward Potts, so well known to zoologists by his researches on fresh-water sponges

The methods of preparing an accurate survey of the plants growing in a plot of pasture or meadow-land is the subject of a small brochure by the Rev E A Woodruffe-Peacock published as No 9 of the Rural Science Series The system here explained in detail is recommended to the consideration of students taking up floral analysis from a biometric standpoint

Selecting as his subject the financial success of forest management, Dr W Schlich, F R S, delivered a lecture before the students of the Royal Agricultural College, Cirencester, that is published in the December (1906) number of the *Agricultural Students' Gazette* While the lecture contains no new facts, it provides an excellent summary of guiding principles, and as a practical illustration Dr Schlich quotes from the working plan drawn up by him for the Alice Holt crown forests in Hampshire

A question that must frequently occur to fruit-growers is concerned with the causes that control the time of flowering of trees An attempt to calculate in a general way the number of heat units received in different years is discussed by Mr F P Sandsten in Bulletin No. 137 issued from the agricultural experiment station of the University of Wisconsin As would be expected, conditions during the previous summer and autumn are no less potent than temperatures in the spring, while less important factors are connected with the condition of the soil and the characteristics or state of health of each individual plant The author mentions that the number of units required to bring a tree to flower varies from year to year, but does not state whether the proportion of heat units required by different varieties remains constant, although it would appear that data suitable for deciding this point were collected

The Engineering Standards Committee has issued tables of British standard Whitworth screw threads, of British standard fine screw threads, and of British standard pipe threads The tables can be obtained, post free, for a penny, from the offices of the committee, 28 Victoria Street, Westminster

In the discussion on Mr H Campbell's paper on suction engines and gas plants, read before the Institution of Engineers and Shipbuilders in Scotland (Transactions, vol I, part iii), Mr F J Rowan gave a bibliography of the subject, bearing witness to the enormous amount of investigation and research that has been carried out during the past two or three years

INVESTIGATIONS have shown that the yellow crystalline substance deposited from solutions of ammonium molybdate has the composition H_2MoO_4,H_2O. It was noticed as early as 1876, identified in 1882, and a crystal measurement made in 1903. The properties of this interesting chemical curiosity form the subject of a paper by Mr. J. H. Graham in the Journal of the Franklin Institute (vol. clxiii., No. 1).

IN the *Engineer* of January 25 plans are given of the handsome and commodious new headquarters of the great American engineering societies in New York provided by the liberality of Mr. Andrew Carnegie. The two top floors are devoted to the libraries of the several societies, and it is intended so to administer the library of each that by bringing them together there may be created an extremely complete and valuable library of engineering science and practice.

STRIKING evidence of Japan's native industrial capacities is afforded by an admirably illustrated description, by Mr. O. G. Bennett, of Sumitomo Bessi, the great copper mine of Japan, in the *Engineering Magazine* (vol. xxxii., No. 4). Copper mining has been carried out for centuries at this peak of sulphide copper ore near the centre of the island of Shikoku. At the present time, 9000 tons of ore are raised daily by plant modern in all engineering details, the transformation from the primitive methods having been wrought without the direct assistance of a single foreign engineer.

THE presidential address delivered by Mr. F. W. Taylor, of Philadelphia, to the American Society of Mechanical Engineers is summarised in the *Engineer* and in *Engineering* of January 11. The author, one of the inventors of the modern high-speed steels, has written an address on the art of cutting metals that deserves to become one of the engineer's classics. It is probably, both on account of its length and on account of the matter it contains, one of the most remarkable that has ever been offered to a learned society. It contains the main results of twenty-six years' study of the question of obtaining the maximum output from machine tools. As the best high-speed tool steel the author recommends a steel of the following composition:—vanadium, 0.32 per cent. to 0.29 per cent.; chromium, 5.95 per cent. to 5.45 per cent.; manganese, 0.07 per cent. to 0.11 per cent.; tungsten, 17.81 per cent. to 18.19 per cent.; carbon, 0.682 per cent. to 0.674 per cent.; and silicon, 0.049 per cent. to 0.043 per cent. He has succeeded in establishing formulæ sufficiently trustworthy for the production of slide-rules by means of which it is possible to determine in a few minutes the best speed and feed to use in executing any given piece of work in any given lathe, and with any given set of tools.

IN one of the very valuable Bulletins (No. 275, Washington, 1906) recently issued by the United States Geological Survey, Mr. T. Nelson Dale describes the slate deposits and slate industry of the United States. It covers 154 pages, with twenty-five plates and fifteen illustrations in the text, and deals with the origin, composition, and structure of slate in general, and the slate deposits of the United States in particular. A full bibliography of slate and a glossary of geological and slate-quarrying terms are appended. The classification of slates adopted by the author is as follows:—I., aqueous sedimentary. A, clay slates, B, mica slates; (1) fading: (a) carbonaceous or graphitic, (b) chloritic, (c) hæmatitic and chloritic; (2) unfading: (a) graphitic, (b) hæmatitic, (c) chloritic, (d) hæmatitic and chloritic. II., igneous. A, ash slates, B, dyke slates. The scientific basis for these subdivisions is explained, and the microscopic and chemical analyses of typical slates are given. The Old Bangor quarry, Northampton County, Pennsylvania, is the largest slate quarry in the United States. The deposit measures 1000 feet along the strike, 500 feet across it, and 300 feet in depth. The general structure is a close, overturned synclinal crossed by almost horizontal cleavage. The thickest bed of good slate is 9 feet thick. The product from the large beds is used for roofing, but that from the ribboned beds goes into mill stock. The value of the United States slate production in 1904 was 1,103,439l.

Old Bangor Slate Quarry, Bangor, Pa., S.S.W. End showing the eroded overturned close syncline crossed by almost horizontal cleavage.

A PAPER on internal-combustion engines for marine purposes, by Mr. J. T. Milton, was read at the Institution of Civil Engineers on January 22. The economy and the increasing use of internal combustion engines on land has led to considerable interest being taken in their application to marine purposes, and already a large number of such engines have been fitted in small craft on the Continent, in most of which heavy mineral oil is the fuel used. On land, various fuels are used for these engines, namely, petrol, refined oil, heavy oil, coal-gas, producer-gas, coke-oven gas, and blast-furnace gas, but for marine purposes generally producer gas and heavy oil are at present the only available fuels. The special conditions required for a successful marine engine are:—(a) the engine must be reversible; (b) it must be capable of being quickly

stopped and of being quickly started, either ahead or astern, (c) it must be capable of being promptly speeded to any desired point between full speed and dead slow, which latter speed ought not to be greater than one-quarter of the full speed, (d) it must be capable of working well, not only in smooth water, but in heavy weather in a seaway in which the varying immersion of the propeller causes rapidly changing conditions of resistance In marine engines the revolutions are practically proportional to the speed of the ship, and as the vessel's resistance increases much more rapidly than the speed, it follows that for a reduction of speed of revolution the mean effective pressure must be reduced much more than in proportion to the revolutions This is a much more difficult problem in marine engines, where no fly-wheel is practicable, than on land, where the use of a heavy fly wheel permits the suppression of alternate fuel charges

A LITTLE essay of twenty-four pages has been published by M Prosper de Lafitte on "The Magic Square of *n* with *n* Numbers" By this is meant a square with n^2 spaces, containing the numbers from 1 2, 3, *n* each repeated *n* times in such a way that each row each column and each diagonal contains each number once. This is, of course a slightly different problem from that of the ordinary magic square which contains all the numbers from 1 up to n^2, and the author's claim to have produced a paper calculated to instruct as well as to entertain the reader is well justified Messrs Gauthier-Villars of Paris are the publishers

IN the *Atti dei Lincei* xv, 10, Dr Pietro Macchia discusses the relations between thermal conductivities at ordinary and at low temperatures In determining the conductivity, observation is made of the distribution of temperature in a rod subject to surface radiation when the flow of heat has become steady Even at moderate temperatures results based on Stefan's law are shown to be better than those derived from Newton's law of cooling Thus for pure lead, the ratio of the conductivities deduced from Stefan's law, for temperatures 18° and 100° respectively, works out at 1 016, Jäger and Diesselhorst's determinations, based on the consideration of non-stationary states give 1 015 while the assumption of Newton's law gives 2 01

MESSRS A E STALEY AND CO, of 19 Thavies Inn Holborn Circus, E C, have submitted for our inspection a pair of their new "Nikos," 8×, prismatic binoculars which are sold at the low price of 6*l* 10*s* The instrument is beautifully finished in Russia leather, and is of a very compact, light, and handy form whilst its performance optically satisfied the critical tests to which we subjected the pair examined There is a common focussing screw for both eye pieces, one of which is fitted however, with a separate arrangement, and the bending bar is adjustable to the distance between the observer's eyes by simply bending it the required amount Both the special focussing arrangement and the bending bar are provided with scales so that the habitual user may adjust the glasses before using them without having to make a series of trials each time A pair of studs projecting from the object-glass end of the glasses enables the latter to stand flat on any horizontal surface

THE issue of "Hazell's Annual" for 1907 is now available The alphabetical arrangement of this cyclopædic record reduces the trouble of reference to a minimum, and the comprehensive character of the contents makes the volume of wide interest

A THIRD edition of "The Mechanism of Weaving," by Mr Thomas W Fox, of the Manchester Municipal School of Technology, has been published by Messrs Macmillan and Co, Ltd The opportunity has been taken to revise the text carefully, to add matter relating to recent developments in weaving, to introduce numerous new illustrations, and generally to enhance the value of the work from the points of view of teachers, students, and men actively engaged in the cotton industry

THE thirteenth edition of "Practical Sanitation," by Dr George Reid, has been published by Messrs C Griffin and Co, Ltd The appendix on sanitary law, by Mr H Manley has been entirely re-written, and other parts of the work have undergone detailed revision, particularly the chapter which deals with sewage disposal The work provides medical officers of health, sanitary inspectors and others interested in sanitation with a comprehensive survey of the practical and scientific aspects of sanitary science

WE have received a copy of the first number of the *African Monthly*, a magazine to be devoted to literature, history, exploration, science, and art, as well as fiction The new periodical is published by the African Book Company Ltd of Grahamstown Cape Colony, and its price is 1s The contents of the first issue are varied and interesting, scientific subjects are represented by two articles "The Bantu in the Tenth Century As described in Extracts from the 'Golden Meadows' of Al Mas'udy," by Mr W Hammond Tooke, and "Merino Sheep Breeding in Australia," by Mr R H Harrowell The magazine may be obtained in this country from Messrs Wm Dawson and Sons Ltd, Cannon House, Breams Buildings, London, E C

OUR ASTRONOMICAL COLUMN

THE RECENT TOTAL ECLIPSE OF THE SUN —A telegram received by Prof Kreutz from Prof R Schorr at Dschisak in the province of Samarkand, states that during the whole time that the sun was eclipsed on January 14 the sky was totally obscured, and snow fell heavily Only meteorological and some photometric observations were possible (*Astronomische Nachrichten*, No 4150)

Herr Archenhold has received a similar message from another observer at Samarkand, whilst the Moscow observers are reported to have obtained no results even in the meteorological and photometric programme (*Das Weltall* January 15)

THE SOLAR RADIATION —The depression of the "solar radiation" during 1903, as observed at Warsaw, is dealt with in a paper communicated to the *Bulletin météorologique du Département de l'Hérault* by M Ladislas Gorczyński The observations showed that between December, 1902, and February, 1904, the radiation was abnormally low as compared with the mean for the years 1901–5 This phenomenon has previously been commented upon by various observers, and is supposed to have been due to the large amount of volcanic dust in our atmosphere Two other abstracts from the same bulletin deal respectively with the variations of the intensity of the solar radiation with the height of the sun, and the amount of the insolation at Warsaw, Treurenberg, and Montpellier

PHOTOGRAPHS OF GIACOBINI'S COMET (1905c) —The way in which a comet's tail develops as the comet approaches perihelion is beautifully shown by a series of photographs of Giacobini's 1905 comet which are published in Bulletin No 25 of the Lowell Observatory The series extends from December 14, 1905—eight days after the comet's discovery—when the object showed only a well-defined nucleus, to January 7, 1906, when three distinct tails are shown, the middle one extending to a distance of 10° from the head

On December 29 two tails were shown, one of which was made up of four distinct streamers with nebulous matter between them, two of these streamers were crossed so as to present a twisted appearance, whilst the two outside ones diverged in the usual manner On no two negatives are the images the same, the day-to-day development being very marked Between January 3 and 4 there was a decided change in the position-angle of the extremity of the tail, which is shown in a striking manner by the superposition of the two orientated images, and is somewhat similar to that recorded by Prof Barnard in the case of Brooks's comet 1893 iv

THE RED SPOT ON JUPITER, 1905–6 —The results of Mr Stanley Williams's observations of the Great Red Spot during the opposition of 1905–6 appear in No 4150 of the *Astronomische Nachrichten* The transit times of the spot were all observed by simple eye estimates, care being taken to avoid looking at the Red Spot Hollow, which as compared with the spot itself, was a very conspicuous feature The rotation period as determined from 635 rotations, was found to be 9h 55m 41 46s, a value slightly less than that determined from the 1904–5 opposition The mass of dark material which circles round the belt in which the spot is situated overtook the spot during the last week in March 1906

Micrometer measures made during the period November 1905, to February 1906 showed the mean longitude of the Red Spot Hollow to be 29° 41 a position some 1° 3 following the spot itself Mr Williams discusses the relative accuracy of the micrometer method at some length and from his experience, arrives at the conclusion that it is likely to introduce errors due to the alteration of the appearance of the observed feature caused by the superposition of the micrometer wires a conclusion which is confirmed by other observers of Jovian phenomena

A PECULIAR SHORT-PERIOD VARIABLE (155 1906 CASSIOPEIÆ) —From a number of observations made at Potsdam during 1906, Messrs Müller and Kempf find that the sixth magnitude star B D +68° 200 is a variable, with a period of 1 95 days and a remarkably small range of light variation the whole amplitude amounting to only 0 33 magnitude (*Astronomische Nachrichten*, No 4148)

THE BRITISH SCIENCE GUILD

THE first annual meeting of the British Science Guild was held at the Mansion House on Monday, January 28 Just fifteen months have passed since the inauguration of the Guild in October, 1905 and the very large gathering of sympathisers with the new movement was eloquent of the fact that the hopes and confident expectations of its organisers have not been disappointed The Lord Mayor Sir W Treloar, presided, and was supported by the president, the Right Hon R B Haldane and Sir Norman Lockyer the chairman of committees Many eminent representatives of science, industry, and the educational world were present

The Lord Mayor having opened the meeting by offering a warm welcome to the Guild, Sir Norman Lockyer gave an outline of work accomplished since its inception, touching on the main points mentioned in the report of which the following is an abstract The first part was purely historical. It stated what the committees have done Though their activities have not figured so prominently before the general public outside, it must be remembered that the more important the work was going to be, the more quiet must it be in the first instance The first public outcome of the Guild was connected with the report of the Departmental Committee appointed to consider the question raised by the proposed new Technological Institution at South Kensington, and the fear that the scheme might be delayed in consequence of certain differences of opinion as to the constitution of the governing body The result was the letter to the *Times* last year, in which the Guild urged most strongly that neither the question of the ultimate and final relationship of the new institution to London University nor any other matter should be allowed to interfere with the immediate appointment of at least an organising governing body

The next important point to which the report refers was that of the grant to the National Physical Laboratory it described the happy result of Mr Haldane's interposition with the Treasury in obtaining an increase of the grant from 5000*l* to 10 000*l*

At the request of various bodies the Guild has taken part in several important deputations Sir John Cockburn represented the Guild on a deputation to the President of the Board of Trade urging the importance of the compulsory working of patents

On account of certain changes contemplated by the Government, the council of the Royal Society of Edinburgh asked for the support of the Guild in the matter of obtaining suitable buildings to house the society, and also a suitable grant for yearly expenses This support was most cordially given by the executive committee The sum originally proposed to be expended by the Government on the new buildings was 14 000*l*, but the final result of the action of a committee and of the representations made by the deputation on which the Guild was represented by Sir W Ramsay, K C B, was to secure for the society a sum of 25 000*l* for the purchase of a building, 3000*l* to cover the expenses of fitting it up and a yearly grant not exceeding 600*l* a year The council of the Royal Society of Edinburgh has expressed the opinion that these arrangements are quite satisfactory (see p 205)

Several communications were received from the officers of the Marine Biological Association urging the Guild to form part of a deputation to the Chancellor of the Exchequer on the subject of the continuation of the grant in aid of the International Fisheries' Investigations Sir Michael Foster, K C B, was nominated to represent the Guild on the deputation which introduced by the Right Hon Austen Chamberlain, M P was, in the unavoidable absence of the Chancellor of the Exchequer, received by the Parliamentary Secretary, Mr McKenna M P on December 18 1906 (see p 185)

In June the Guild received a communication from the anthropometric committee of the British Association in relation to a deputation to the Prime Minister urging him to appoint a commission to carry out a periodic anthropometric survey of school children and adults It is proposed that this commission shall be constituted on the same lines as the advisory council recommended by the Physical Deterioration Committee and preferably should be under the direct control of the Prime Minister like the Defence Committee The proposed anthropometric survey would also be on the lines recommended by the Physical Deterioration Committee The executive committee considers the proposed survey is a most important application of science to statecraft and has nominated a representative of the Guild to attend the deputation which the Prime Minister has consented to receive after the recess

The education committee has had before it a proposal to form two new committees, one dealing with elementary and secondary education especially in relation to the introduction of leaving certificates from the primary school and the importance of practical scientific training in both It was proposed that the second educational committee should consider the question of an increased endowment of universities by the State Referring to this committee Sir Norman Lockyer remarked that the private endowment of American universities last year amounted to five millions sterling It is hard for us as a nation to compete with that Germany is strengthening its universities just as thoroughly as it is strengthening its Fleet a reminder that we ought to be able to compete with other nations in the preparation and equipment for industrial progress as well as for war

The report recorded the overtures made to the Franco-British Exhibition Committee as the outcome of which the exhibition committee's desire to include science in their programme was stated The assistance of the Guild was asked in the formation of the science section and it was now proposed that lectures should be given during the continuance of the exhibition by British and French men of science

The progress of the Guild was indicated by the membership of 590, and by the fact that already branches are being formed in Canada and Australia

Mr Haldane then rose to move that the record of action summarised in the report be approved He endeavoured, first, to answer a possible criticism of this record Some might think that it was not startling or striking, and foretold no revolution to be effected But the founders of the Guild never believed that progress could come rapidly Nothing but strenuous labour in educating the public would bring home to the public mind the depth and reality of the conviction on which this British Guild of Science was based, that Knowledge was Power Nevertheless, Mr Haldane disavowed a pessimistic outlook There was much that was encouraging Go where they would, applied science was taught in a fashion in which it was never taught a few years ago, and he instanced three universities which he had himself recently visited—Glasgow, Manchester, and Liverpool, at Birmingham and London also the tendency was not less visible We did not notice it, but it had been noticed by the Continent "I have been struck more than once by the emphatic testimony given by Continental experts to the progress which has taken place in Great Britain, which is, they say at the present time, relatively speaking, more rapid than the progress in other parts of the world Well, we have much to make up America has been ahead of us and I do not think it is only endowment I think it is the practical spirit of the American people which has made them realise how essential it is to a country which is leading the industrial world that the best science should be at the disposal of all the manufacturers. Canada herself is in some respects ahead of this country There is a technical equipment in the McGill University, Montreal, the like of which we hardly know, and it is not contrary to what one likes to see that our own young men should be taking advantage of the opportunity which that University offers to go and get the highest training in some branches of applied science under the British flag "

Mr Haldane attributed some good in this respect to the fiscal controversy It was demonstrated that we had gone back, because we were using antiquated methods in competition with those who used new and more scientific methods All this had stirred up many of our great captains of industry and to-day brains had a better market than they had had for a very long time past in Great Britain Reviewing all these things Mr Haldane thought they ought to make us hopeful Scientific education was no longer at a discount He directed attention to his own department of administration at the War Office, for this new movement was not confined merely to private industry, we train our young officers he said, as they were never trained before and we have an average of scientific attainment among our young officers such as has not been seen at any previous time in the British Army Then he pointed out another thing which he thought, lent itself to the objects of the Guild and that was the extent to which the private employer is giving way to the joint-stock company The joint-stock company had its disadvantages but under it more and more the price of brain was the price which was paid to the manager, and less and less to the private capitalist More and more science was thus levelling opportunity, and giving to everybody the chance of making himself a power among his fellow-men

Mr Haldane concluded his interesting speech with these words on the relation of the State to science —" All this costs money, and if the State is to play its part in it, it must cost the State money Well, but the national income is increasing These very things give a reward which is four-fold or ten-fold more than the expenditure necessary to earn it There are those who put our national income somewhere between 1600 millions and 2000 millions at the present time Well, our expenditure under the Imperial Government is well within 10 per cent even if you take the lowest of those figures, and surely 10 per cent is not much for a people to contribute to get advantages so enormous as we see on every side to-day Education, improved surroundings equality of opportunity to a degree we have never known before, increase of the national production—all these things are well worth purchasing at an expenditure which means only a fraction of that 10 per cent, and I say that if the State only spends its money wisely the State will make no better investment for those for whom it is responsible than an adequate expense on the development of scientific method Our problem is to awaken our country There are many others engaged in that work This Guild is only one of several organisations, but it contains on its roll perhaps more distinguished men of science than any other society which is engaged in a like work Our business is to act in the true missionary spirit, and, acting in the true missionary spirit, we have to see to it that our energies do not flag and that we do not allow the sun to go down before our labours are complete "

The Hon and Rev E Lyttelton, the headmaster of Eton College, followed Mr Haldane He had been astonished at the zeal shown by the committee, and his agreement with the previous speaker's hopefulness was shown by the remark —" I have never yet taken part in any movement which seemed to me so absolutely certain to have a lasting and deep effect upon the life of the country than this one " He was greatly struck with the progress of the scientific spirit in the educational world There was no subject now taught in schools in the same way as it was taught in schools thirty years ago " If that has been done at a time when many schoolmasters have been vocal with indignation at the encroachment of science on their private domain, how much more will be done in the next thirty years, when we have grown wise enough to see that whatever be the blessings of a literary education, there is not the slightest reason why in every school there should not be a combination of literary education with scientific training " This much-agitated conflict between literature and science in university circles was commented on in a striking way by a later speaker—the Vice-Chancellor of Cambridge University Dr F S Roberts The Vice-Chancellor of Oxford University was, unfortunately, unable to be present, but Dr Roberts pointed out as a happy omen the fact that that gentleman, as well as Mr Lyttelton and himself, were all representatives of literature and yet were all very keen advocates of science

Mr Alfred Mosely offered some interesting remarks on the teaching of science in America, and Prof Meldola took the opportunity of correcting a notion which existed in some quarters that the Guild was specially interested in the practical and industrial application of science He wished to see the encouragement of scientific method as a cult The work of the Guild, he hoped, would be to raise the level of public opinion towards abstract science itself The rest would follow

The other business resolutions included one to permit of distinguished Americans and foreigners being elected honorary members—an extension of the basis of the Guild due to the courtesies and offers of information from eminent Americans

The following executive committee for the ensuing year was elected The new members are indicated by italics — *President*, Right Hon R B Haldane, M P , F R S , *hon treasurer* Right Hon Lord Avebury, F R S , *hon assistant treasurer*, Lady Lockyer, *trustees*, Sir James Blyth, Bart , Mr C W Macara , *vice-presidents*, *Sir Archibald Geikie*, F R S , Sir John Wolfe-Barry, K.C B , F R S , *chairman of committees*, Sir Norman Lockyer, K C B , F R S *vice-chairmen of committees*, *Sir William Ramsay*, K C B , F R S , Sir Lauder Brunton, F.R S , Hon Sir John Cockburn, K.C.M G , *Sir Philip Magnus*, M P , *hon secretary*, *Sir Alexander Pedler*, C I E , F R S , *members*, Sir Hugh Bell, Bart , Mr G T Beilby F R S , Right Hon. Thomas Burt, M P , Mr. Dugald Clerk, Captain Creak, C B , R N , F R S , Dr Francis Elgar, F R.S , Prof Meldola, F R S , Sir William Mather, Major-General Sir F Maurice, K C B , Prof J. Perry, F R S , *Sir William White*, K.C B., F.R S., Mr Carmichael Thomas, Mr. F. Verney, M P., Sir Henry Trueman Wood, *Sir Edward Brabrook*, C.B.

The following new vice-presidents were appointed:— Lord Reay, president of the British Academy; President Warren, Vice-Chancellor of the University of Oxford; the Vice-Chancellor of the University of Cambridge; Sir Frederick Pollock, Bart., and Sir David Gill, K.C.B., F R S

AMERICAN FOSSIL CYCADS[1]

THE wonderful state of preservation of many Palæozoic plants, which has enabled us to gain much valuable information in regard to phylogenetic problems is in marked contrast to the general absence of petrified fossils afforded by Mesozoic strata Thanks to the ability and energy of Mr G R Wieland, liberally backed by the Carnegie Institution, a flood of light has been thrown on the morphology of an extinct group of Mesozoic gymnosperms, which it is possible to study with a precision and thoroughness hardly to be surpassed in the case of recent plants Mr Wieland's monograph, with its splendid set of large plates, is an addition to botanical literature of exceptional importance After reading the volume, we couple with a grateful acknowledgment of what has already been done an earnest wish that the results of further investigations may be presented in an equally attractive form in the near future.

Mesozoic plant-bearing rocks in almost all parts of the world are characterised by an abundance of pinnate fronds, recognised by Brongniart and by other pioneers of palæobotany as cycadean on account of their close agreement in external characters with those of modern cycads—a small group of tropical gymnosperms occasionally extending into subtropical regions, which constitute an unobtrusive assemblage of survivals from a remote past Stems which might reasonably be supposed to have borne these fronds have until recently been met with in a few localities only, and never in great quantity, except, perhaps, in the Purbeck beds of Portland As Wieland says, it is with the work of the English botanists Carruthers and Williamson (1868) that the exact investigation of fossil cycadean stems "may be said to have fairly begun" The famous species *Bennettites Gibsonianus* of Lower Greensand age, discovered many years ago in Luccomb Chine in the Isle of Wight, first described by Mr Carruthers and afterwards by Prof Graf zu Solms-Laubach, has made us familiar with the striking differences between the reproductive shoots of this extinct type and those of existing cycads, differences of surprising magnitude in view of the close resemblances as regards habit and vegetative anatomy Other European examples of Bennettites have been described by Profs Cappellini and Solms Laubach, and an exceptionally well-preserved French Liassic species by Prof Lignier, of Caen In 1860 Philip Tyson discovered a few silicified cycadean stems in the Potomac formation of Maryland, but these were not submitted to more than a superficial examination, it was not until the last decade of the nineteenth century that the late Prof Marsh, of Yale, with an energy worthy of a pupil of Goeppert, secured a collection of more than 700 petrified stems from the Upper Mesozoic rocks of the Black Hills of Dakota and Wyoming European botanists who have had an opportunity of seeing some of these relics of cycadean groves of the Upper Jurassic and Lower Cretaceous periods in American museums have eagerly waited for the publication of Mr Wieland's investigations, and the preliminary papers which he contributed to the *American Journal of Science* (1899–1904) served to intensify the impatience with which the more complete descriptions have been awaited

In chapter i the author gives an interesting summary of collections of cycadean stems, chapter ii is devoted to their preservation and external characters In chapter iii we read of the difficulty of attacking these enormous flint-like fossils, and of the ingenuity by which the silicified trunks were made accessible to minute examination Tubular drills were found to afford the best results, photographs of some of the drilled stems remind one of cylindrical cheeses to which the taster's scoop has been freely applied

Chapter iv, treats of internal structure, many of the facts recorded merely confirm what was previously known, but additional information is given in regard to the anatomy of vegetative organs which makes us wish for further details in regard to many points still left in doubt or incompletely dealt with We should like to know more about the relative abundance of centrifugal and centripetal wood in the leaf-traces, we are curious to know whether the Bennettites stems usually possessed one cambium-zone or several, and it would be interesting to have more definite statements as to the histological characters of the secondary wood It is not improbable, as Mr Wieland suggests, and as the writer suspected from an examination of a silicified cycadean stem from India, that these Mesozoic stems, in some cases at least, differed from modern cycads in the greater compactness and hardness of their wood No one recognises more fully than Mr Wieland how much remains to be done, and he promises to do his best to fill up these and other lacunæ In chapter v we have an exceedingly interesting account of the vernation and structure of young fronds preserved in buds on the main trunk It is a curious fact that, despite the extraordinary abundance of stems, detached fronds have not been found in the enclosing strata, a circumstance which enhances the value of the discovery of unexpanded pinnate leaves in organic connection with the stem

FIG 1 —*Cycadeoidea Marshiana* Longitudinal section through ovulate strobilus s = remnant of dehiscent disc of microsporophylls

It is, however, in chapters vi and vii that we find by far the most important part of the author's work The researches of Carruthers and other authors have shown that Bennettites did not bear terminal, or in some cases apparently terminal, flowers as do the true cycads but produced axillary branches consisting of a comparatively short axis ending in a terminal receptacle crowded with two sets of appendages, slender stalks terminating in single orthotropous seeds associated with sterile organs probably homologous with the seed-bearing pedicels, termed interseminal scales, which overtopped the small seeds and almost completely enclosed them in a protecting envelope These axillary shoots usually occur in profusion on a single stem, and, as Wieland points out, often in approxi-

[1] "American Fossil Cycads" By G R Wieland Pp. viii+284+plates. (Published by the Carnegie Institution of Washington, 1906.)

mately the same stage of development, it may be, as he suggests, that the plant did not fruit until reaching maturity. The seeds of Bennettites are in size like "small grains of rye", they seem to be exalbuminous, and have little in common with the enormous seeds of recent cycads. With the exception of a single Italian species, in which Solms Laubach found a few pollen grains associated with a female flower, we were in complete ignorance as to the nature of the male flowers until the publication of Wieland's results. It was usually assumed that in Bennettites, as in true cycads, the flowers were unisexual. Whatever interpretations we put on the morphological value of the interseminal scales and seed-bearing pedicels, it is clear that the female flowers of the fossil genus are characterised by a morphological plan far removed from

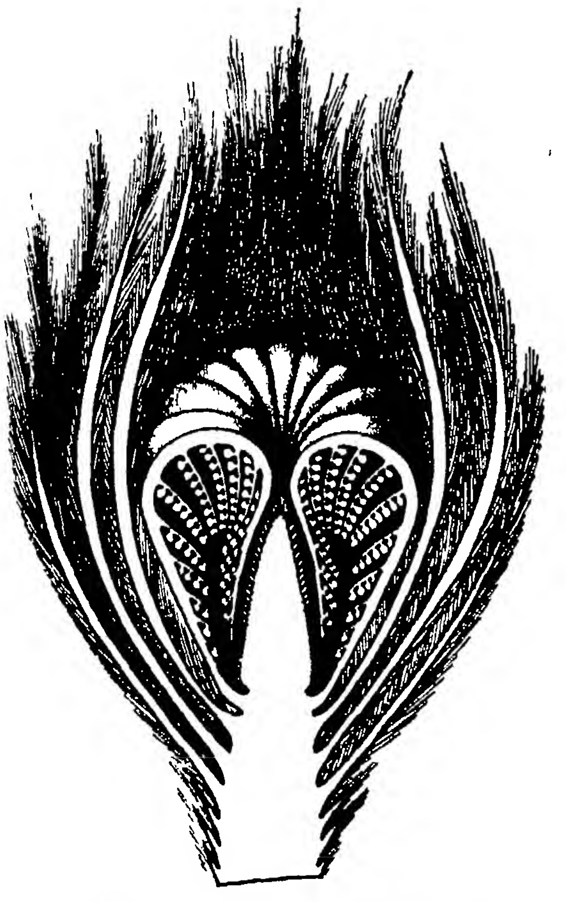

FIG. 2.—Restoration of unexpanded bisporangiate strobilus showing enveloping bracts, folded microsporophylls and conical receptacle bearing short ovuliferous pedicels, &c.

that of the leaf-like carpels of Cycas and from the crowded carpellary scales of other recent genera.

Mr. Wieland has conclusively proved that previous views as to the unisexual character of the Bennettites flowers are incorrect; in most cases, at any rate, the flowers were bisexual. He figures several examples of reproductive shoots terminating in ovulate flowers like those of *Bennettites Gibsonianus* bearing a basal rim (Fig. 1, s) to which was formerly attached a hypogynous whorl of pinnate microsporophylls with pinnules reduced to an axis producing numerous synangia and microspores. This assumption as to the former association of microsporophylls with a central group of ovuliferous pedicels is justified by the discovery of numerous examples of bisexual flowers, consisting of an axis terminating in a conical receptacle bearing the two sets of organs characteristic of what have previously been styled female flowers, but differing in the smaller size of the seed-stalks and interseminal scales, and presenting the appearance of partially aborted or immature female organs. Surrounding this central receptacle there is a whorl of several pinnate leaves with their upper portions folded inwards between the petioles of the central gynœcium (Fig. 2), and bearing rows of synangia of a type but little removed from those of modern marattiaceous ferns. No specimen has so far been described of a bisexual flower in which both andrœcium and gynœcium are mature. There appear to be two possible explanations: are these bisexual flowers comparable with the male flowers of Welwitschia (Tumboa), in which the female portion is functionless, or have we a case of dichogamy, in which the male organs matured first, and were subsequently shed? This discovery, first announced in a short paper by Mr. Wieland in 1899, is of the greatest importance as demonstrating the retention in a comparatively little altered form of filicinean synangia and spores of the marattiaceous type side by side with female organs which foreshadow the angiospermous gynœcium. It is impossible in the space at our disposal to attempt to deal with the numerous questions of phylogeny—the probable line of evolution of the Bennettitales and their relationship to modern cycads—but we naturally ask, Is it fitting to speak of plants possessing this type of flower as cycads? The term cycads used by the author is perhaps justifiable if adopted in the widest sense, but the reviewer cannot help feeling in sympathy with a view expressed in a letter recently received by him from Prof. Nathorst, of Stockholm, that the extension of the designation cycads to plants so far removed in the organisation of their essential organs from the cycads as we know them necessarily tends to minimise the importance of fundamental differences.

The generic name Cycadeoidea, proposed by Buckland in 1827, is used by the author in preference to Carruthers's genus Bennettites; it would, we think, be better to retain the latter name for all cycad-like stems possessing the lateral fertile shoots of the type originally described by Mr. Carruthers. There is another very different form of stem which Nathorst discovered in the Rhætic plant beds of Scania bearing fronds long known as a species of Anomozamites and flowers which probably agreed closely with those of Bennettites. This stem, which Nathorst names *Williamsonia angustifolia*, is important as demonstrating the wide range of vegetative variation within the great group Cycadophyta. The discoveries of Mr. Wieland, Prof. Nathorst and others demonstrate the impossibility of forming any adequate conception of the nature of the Cycadophyta—to use Nathorst's convenient term—if we confine our attention to the meagre remnant of that phylum which has survived the revolutions in the plant kingdom since the beginning of the Cretaceous era.

In the concluding chapters Mr. Wieland deals with questions of phylogeny; while recognising much that is suggestive in the treatment of this difficult subject we feel that there is a certain vagueness in his conclusions which, though partly due to lack of data, is perhaps to some extent the result of a want of clearness and conciseness of treatment. The initial difficulties have, however, been surmounted, and Mr. Wieland has completed with conspicuous success a very important section of the work; we close the volume with a desire for more, and heartily wish the author further success in a field where the opportunities are unrivalled. A. C. S.

THE RECENT HIGH BAROMETER

A REGION of exceptionally high barometer readings over western Europe was a feature of especial interest during a great part of January, the mercury in many places attaining to a greater height than any previous record, while elsewhere the readings have scarcely been exceeded. To trace the history of this anticyclonic region and to attempt any explanation requires a series of synchronous and synoptic charts embracing a large part of the northern hemisphere; possibly this may be undertaken by one of our European weather offices when all the facts have been collated. It would seem that vessels traversing the Atlantic have in many cases experienced

barometer readings much in excess of the average during the whole voyage, and for the greater part of the month.

As early as January 4, a region of high barometer, with readings 30·4 inches, spread in over the Bay of Biscay from the Atlantic; this gradually extended eastwards over south-western Europe, and on January 12 the region intensified, readings of 30·7 inches occurring over the Bay of Biscay and western France. The anticyclone maintained its ground, and on January 17 and 18 was distinctly spreading northwards, the isobar of 30·5 inches embracing France, England, Denmark, and the greater part of Norway and Sweden. On January 20 the anticyclonic area was greatly augmented, apparently by an independent region of high barometer spreading down from the extreme north of Europe. The highest readings—30·9 inches—were situated over Lapland and Finland, and on January 21 the highest pressure was in the vicinity of the White Sea, the barometer at Archangel reading 31·39 inches. On January 22 the anticyclone was central over northern Russia, the barometer at Kuopio standing at 31·46 inches. The maximum height of the barometer was attained on January 23, when at Riga the reading was 31·58 inches, and the region of 31 inches and above embraced parts of England, Scotland, and Ireland, the barometer at some of the stations in the British Islands being higher than any previous record. The high barometer area continued to travel southwards, and on January 26 the centre was in the neighbourhood of Constantinople but the highest reading had then decreased to about 31·1 inches.

The absolutely highest reading of the barometer on record is 31·72 inches, which occurred at Irkutsk on December 20, 1896, and at Semipalatinsk on December 16, 1877. The highest in the British Islands is 31·11 inches, at Aberdeen on January 31, 1902, and 31·10 inches at Fort William on January 9, 1896. The lowest reading on record at the surface of the earth, and reduced to sea-level, is 27·12 inches, at False Point on the coast of Orissa, on September 22, 1885, and the lowest in the British Islands 27·33 inches, at Ochtertyre on January 26, 1884.

From about January 20 to January 26 the weather was intensely cold over western Europe, and an easterly wind was blowing for the most part. The Weekly Weather Report issued by the British Meteorological Office shows that, for the week ending January 26, the mean temperature was 9° F. below the average in the midland, southern, and south-western districts of England, and the deficiency amounted to 7° F. in several other districts. The minimum temperatures were as low as 5° F. and 10° F. in many parts.

STAR CATALOGUES [1]

SOME astronomical work is so attractive that it readily finds support and imitation. The preparation of star catalogues scarcely belongs to that category. Such work is dreary and monotonous and those who devote themselves to it are entitled to the acknowledgment that is invariably granted to those who are willing to sacrifice brilliancy to utility. There is little scope for the exercise of originality. Once the scheme is defined, the stars selected, and the needed accuracy attained, there is nothing to break the wearisome repetition of a purely mechanical process. The work can hardly be said to possess the attractiveness of permanence. The observations give the position of the stars at a certain epoch, and almost before the catalogue is available as a whole the work of supplementing it has begun. The wayward and lawless proper motions of the stars tend to render the coordinates obsolete, and this cause alone will necessitate the repetition of the work upon which so much labour has been bestowed. Yet no work requires more care and forethought, and this will be painfully evident to those who read the introductions to the several works, the titles of which are quoted below. It will be equally evident to those who recall the names of those who have devoted themselves to this work, and who will thus be reminded that many astronomers, from Flamsteed to Airy, have been content to stake their reputation upon their contributions to the cataloguing of star places. It is the opportunity for the introduction of greater accuracy that affords the necessary compensation. Sir David Gill, than whom few can look back upon the accomplishment of a greater mass of work, probably views the completion of these catalogues with very considerable satisfaction, and regards them as rounding a well-filled career.

The usefulness of a catalogue will be more readily appreciated if the star places are required to make accessible other material to which it is at present impossible to give a final and convenient form. This is the case with the first of the catalogues on our list. The 8560 stars are not isolated points irregularly distributed over the sky but are generally the brighter stars to be found in the zone allotted for observation to the Cape of Good Hope Observatory by the Astrographic International Congress. These stars form the fiducial points to which the unknown stars of the photographic plates will be referred. The coordinates, determined on one plan, will give great uniformity to the resulting photographic catalogue. All the observations have been made between 1896–9, and since the plates have been taken approximately within the same years, possible errors arising from proper motion are effectually eliminated. Moreover, the advantages arising from employing stars taken at one epoch and observed on one uniform plan are patent. Apparently, in the use of facilities for reducing photographs, observers in the southern hemisphere were at a disadvantage compared with those in the northern, since the latter could immediately bring into use the admirably arranged catalogues of the Astronomische Gesellschaft, but the pains bestowed by Sir David Gill upon this piece of work have entirely reversed the conditions, and placed the Cape Observatory in the most favoured position, for, to a certain extent, he is able to select those stars for the reduction of his measures which are most suitably arranged upon the plate. The northern observers have to accept such stars as have been observed, but in forming a new catalogue, one would naturally observe those stars which will furnish the best data for subsequent reduction. An ideal scheme would be to select for each plate eight stars distributed uniformly round the circumference of a circle of about 55′ in diameter the centre of which coincided with the centre of the plate, and in addition, two stars near the centre of such plate, but owing to overlapping whereby the four corners of one plate become the centres of four other plates, such a scheme does not work out practically, and on the average twelve or thirteen stars, somewhat irregularly situated, will be available for the reduction of each plate, and this number may rise to seventeen or eighteen stars.

The individual results on which the catalogue places rest have been published in the annual volumes. The details here presented enable one to follow the small corrections that have been introduced to eliminate systematic errors and to secure uniformity throughout. To the ledgers of right ascension three terms have been applied, one to reduce the right ascension to what it would have been if Newcomb's system had been adopted, a second correction, depending on magnitude, is required to reduce the R.A. of a particular star to what the observer would have recorded if the star had been of the fourth magnitude. The necessity of the third correction is not very clear. It has been required because of the small number of clock stars employed in each zone, "and perhaps also because of small outstanding errors in the adopted values of Level, Collimation, and Azimuth."

In order to obtain the greatest possible accuracy in the declinations, a system of small corrections has been applied

[1] "A Catalogue of 8560 Astrographic Standard Stars between Declinations −40° and −52° for the Equinox 1900 from Observations made at the Royal Observatory, Cape of Good Hope during the Years 1896–99 under the Direction of Sir David Gill, K.C.B., F.R.S." Pp. lix+403. (London: Printed for H.M. Stationery Office by Eyre and Spottiswoode, 1906.)

"Catalogues of Stars for the Equinox 1900·0 from Observations made at the Royal Observatory, Cape of Good Hope, during the Years 1900–1904 under the Direction of Sir David Gill, K.C.B., F.R.S." Pp. xiii+121. (Edinburgh: Printed for H.M. Stationery Office by Neill and Co., Ltd., 1906.) Price 4s. 6d.

"Astrographic Catalogue 1900·0, Oxford Section, Dec. +24° to +32°. From Photographs taken and measured at the University Observatory, Oxford, under the Direction of Prof. H. H. Turner, F.R.S." Vol. i. Pp. lxvi+123. (Edinburgh: Printed for H.M. Stationery Office by Neill and Co., Ltd., 1906.)

to the values in the annual volumes. These corrections are again three in number —one required by the Chandler change in latitude, a correction depending, apparently, on some function of zenith distance, and which embraces flexure of the telescope and circle, and removes small uncertainties in the refraction tables The necessity for the third correction is a little obscure It is asserted to be necessary on account of small possible errors in the determination of the nadir, or to remove errors arising from abnormal refraction or irregular heating or flexure of the instrument More details as to the manner in which the last correction has been derived would be welcome It is contended that the application is justified, since the amount of the probable error of observation is reduced

A feature of great interest is the comparison between the final places of the catalogue and those given in the earlier Cape catalogues or by other authorities The main object is, of course, to derive the proper motion, but the real interest centres in the systematic deviations from other catalogues, mainly in the discrepancies shown by those of Cordova It is impossible within narrow limits to do justice to this discussion, but the points raised are of the highest importance in observational astronomy, and exercise considerable influence on some questions of cosmical interest

The second work on our list contains four catalogues Two of these are quite small, and can be dismissed forthwith One contains nearly a thousand stars culminating south of the zenith of the Cape Observatory This list includes all stars brighter than 8 5 magnitude which are in the Cape Photographic Durchmusterung, but not in any catalogue of precision, also stars observed with comets or used in survey operations The main portion, consisting of 3365 stars culminating north of the Cape zenith, is of more interest and importance The greater number of the stars is due to the prosecution of a scheme submitted by Sir David Gill to the Comité international des Etoiles fondamentales with the view of forming a zodiacal catalogue sufficiently wide to permit the determination of the moon's place at any observatory and in any part of its orbit by heliometer measures of the distance and position angle of a lunar crater from suitably surrounding stars or of determining in a similar way the position of any of the larger planets Of course, it is not possible to determine with the highest accuracy all stars which may be employed for such purposes, but it is hoped that by concentrating the attention of meridian observers on a select number of stars suitably situated and by adopting processes likely to eliminate systematic errors a very considerable improvement in accuracy may result Several observatories have shown their approval of the scheme by taking part in the observations, and it is hoped that an adequate determination of star places for 1900 will be the outcome, while observations repeated at intervals of twenty-five years would provide all the data required for the most rigorous determination of the places of moon and planets

The third work is different in its design and more comprehensive in its plan The star positions for which the means of reduction are supplied number no less than 65,750, and when it is remembered that these stars are situated in a narrow zone, two degrees in width on the small circle of 31° dec, we are able to learn something of the magnificence of the scheme which proposes to treat the whole sky on a uniform plan What strikes one with the most force is the fact that a small observatory, the funds of which are necessarily strictly limited by the many demands that are made on the university chest, has been able to carry to a successful issue a scheme of such magnitude has competed with the resources of great national observatories, and has found itself second to none Prof Turner has exhibited qualities of administration of the highest order He has known how to impart to a comparatively untrained staff the enthusiasm which he himself experienced, and to secure in every part of the work that uniformity of excellence and rigorous accuracy which are essential for the maintenance of its international repute To him and to the little band which has nobly seconded his efforts we can only offer our heartiest congratulations.

Since Prof Turner has recalled in the most prominent manner to what extent the scheme has benefited by those who were responsible for the conduct of the observatory in the past, it is not out of place to record here that it was the well-placed generosity of Warren de la Rue that enabled the University of Oxford to play a worthy part in the plan which has been brought to so happy a completion It is encouraging to remember that the energy of the late Prof Pritchard was not exhausted, and that, at the age of seventy-nine, he could contemplate embarking upon a new and arduous enterprise. This is the first volume of eight that will appear, and there can be no hesitation in saying that the completion of such a work amply justifies the existence of the University Observatory Twenty years have passed since de la Rue made his gift, and practically for twenty years the staff of the observatory has been devoted to the completion of this task Some slight conception of its extent can be inferred from the fact that the titles of the papers immediately connected with this subject fill more than three quarto pages

At the end of a long article it is impossible to do justice to the many technical points that are necessarily raised in the introduction It must suffice to illustrate the general policy that Prof Turner has pursued This will enable us better to appreciate the exercise of those qualities of administration which have proved so effective The star images have been measured to the thousandth part of the distance between the *réseau* lines, subtending an angle of 300 seconds in the focal plane of the telescope, or the limit of accuracy has been set at 0″3 This may or may not be the greatest accuracy to which it is desirable to aim, but to have attempted another place of decimals would says Prof Turner, have delayed the completion of the work, with the limited staff at Oxford, for several years, and perhaps imperilled its completion altogether This recognition of his limitations has been amply justified Again, it no doubt required considerable self-restraint to confine the measures to one series of images, since greater accuracy would probably have been obtained if the measures had been distributed over more images rather than confined to repeated bisections of the same, but such a process would involve the additional labour of taking means between quantities which were not similar, and so give additional risk of numerical errors Prof Turner is no doubt warranted in asserting that a just relation has been maintained between the labour expended and the accuracy attained W E P

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE —In accordance with the regulations for the administration of the Gordon Wigan fund, the special board for physics and chemistry reports that the first award of the prize of 50*l* from the Gordon Wigan income for physics and chemistry for a research in chemistry has been made to F E L Lamplough, scholar (now fellow) of Trinity College for his research on the determination of the rate of chemical change by measurement of gases evolved

Dr Hobson, of Christ's College, has been appointed chairman for the mathematical tripos, part ii, for the year 1907

A course of lectures on special zoological subjects is being given at the zoological laboratory during the Lent term The course includes lectures by the following — Mr Forster Cooper, on living and extinct elephants, Mr Stanley Gardiner, (1) marine rock formations, (2) the distribution of marine animals, Mr Imms, some recent discoveries in the morphology of insects Mr Perrin, trypanosomes and spirochætes, Mr Potts, parasitism in the Crustacea, Mr Punnett, (1) metamerism, (2) sex, Mr Gadow is lecturing on "Environment and Geographical Distribution of Animals" during the Lent and Easter terms

PROF GEORG KLEBS, director of the botanical institute of Halle University, has been elected to succeed Prof Pfitzer at the University of Heidelberg

DR. REINHARD BRAUNS, ordinary professor and director of the mineralogical Institute of Kiel University, has been appointed successor to Prof H Laspeyres, who retires from the chair of mineralogy and geology in the University of Bonn

THE governors of the Borough Polytechnic recently received an offer from Mr Edric Bayley of 5000*l* towards the estimated cost of the completion of the premises of the polytechnic The governors, therefore, asked the London County Council to assist them by making a grant of 7000*l*, and their request was granted at a meeting of the council on January 23 The cost of the scheme, exclusive of lighting, heating, and equipment, is estimated to be about 11,500*l*

THE annual meeting of the Mathematical Association was held on January 26 at King's College, London The association now consists of 419 members Prof G H Bryan, F R S, was elected president in succession to Prof G B Mathews, F R S During the course of an address, Prof Mathews said he earnestly hoped that the new regulations proposed for the Cambridge tripos would be approved He thinks it will be very unfortunate if, after adopting the principle of the change as the association has done, these regulations are shelved He asked all those who are inclined, from sentimental or other reasons, to vote non-placet on this question to consider carefully whether it is right to do so after this matter has been carefully thought out for many months by men who are representative mathematicians and representative mathematical teachers at Cambridge There is a strong desire at Cambridge to make the mathematical scheme there more living on the one hand, and to bring it more into connection with the general science of mathematics on the other After Prof Mathews's address, papers were read by Prof W H H Hudson on diagrams of anemoids, by Prof A Lodge on contracted methods in arithmetic, and by Mr C S Jackson, on the elementary arithmetic of the theory of numbers

THE current number of *Science Progress* contains an article by Sir Arthur Rücker, F R S, on the economics of university education The essay provides an interesting criticism of Adam Smith's theories of education in the light of modern experience Sir Arthur Rucker leads up to the general criticism that Smith's arguments appear to be based almost entirely on the view that a university is a place where instruction is bought and sold, not a place where professor and student are linked together as leader and follower in a common search after knowledge Incidentally, opportunities are found to insist upon many aspects of education likely to be ignored by the public Thus we read —"as research is largely concerned with the elucidation of the results of hitherto neglected facts, it is found that for many objects mental dexterity can best be fostered by turning the attention of the abler student from the known to the unknown, from information to investigation" In the same number of the review Prof H E Armstrong, F R S, writes on the reform of the medical curriculum, treating it as a problem of technical education Prof Armstrong says that so far as chemistry is concerned "the reform should take the direction of teaching the subject practically and with direct reference to its applications as every branch of chemistry in turn must necessarily be laid under contribution, chemists need have no fear that their field of action will be thereby unduly limited"

THE annual prize distribution and conversazione of the Northampton Institute Clerkenwell E C, was held on January 25 and 26 The prizes were distributed by Mr Evan Spicer, chairman of the London County Council, who in his address to the students made special mention of the importance of the engineering work which was being done at this institute, and of the unique character of the work in technical optics In regard to the latter he remarked that it had received the most sincere recognition of our Continental rivals inasmuch as work of a similar character was being started in France and Austria The principal in his report, referred to the present need of additional accommodation, notwithstanding the fact that the institute has this session occupied the buildings of the British Horological Institute for its technical optics work In the display of instruments made in the various laboratories on both evenings, there were several interesting items A wireless telephone system was made to work successfully across the courtyard, and some interesting experiments were shown with the electric arc used as a telephone receiver, and with the effect of light on selenium cells There was also an interesting display by the Postal Telegraph Department of some of the newest developments in telegraphy, both of the ordinary kind and wireless telegraphy, a complete De Forest set of the latter being at work The 75-ton testing machine and the 50-h p experimental engine were on view for the first time in the mechanical laboratories, and there was also a new 25-K V A alternator built in the institute with special modifications for experimental purposes, from which some interesting results may shortly be anticipated

A SCHEME for the organisation of a central lecture theatre for London, on the model of the Berlin "Urania," is being developed by a representative committee, which includes Sir William Ramsay, Sir W Huggins, and others A meeting was held last week under the presidency of Sir William Ramsay to hear an explanation of the scheme by Mr Albert Wollheim The chairman said he had given two lectures at the Berlin 'Urania' and was much struck with the crowds that visited the institution and constantly occupied themselves gaining knowledge of scientific facts Mr Wollheim explained that the statutes of the Berlin institution exclude the possibility of the undertaking being exploited commercially, all surplus profits, after the distribution of a 5 per cent maximum dividend, are devoted to the purchase of apparatus or to building extensions or carried to a reserve fund The proposed London "Urania" would not clash with the work of the learned societies but would promote their membership Illustrated popular lectures would be given on subjects of interest to the public in a building centrally situated and easily accessible In the summer months the "Urania" would be utilised as a centre for educational visits to museums, gardens of scientific societies, and so on An educational information bureau a library, and a publication department would be features of the institution It is interesting in this connection to recall a similar scheme for a civic museum recently outlined before the Sociological Society by Mr Huntly Carter It may be hoped that the promoters of these ideas will join hands and cooperate in providing London with a valuable adjunct to its existing educational facilities

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, December 20, 1906 —Lieut Col Prain F R S, vice-president, in the chair —*Exhibits* —Two specimens of albino woodlice *Oniscus asellus*, Linn W M **Webb**.—Photograph and dried specimens of *Fockea capensis* Endl a plant of considerable interest on account of its great rarity and its apparently great longevity N E **Brown**.—*Papers* —Report on the botanical collections made by Dr W A Cunnington in lakes Nyasa, Tanganyika and the Victoria Nyanza 1904-5 Dr A B **Rendle** Dr Cunnington spent about three weeks on and about Lake Nyasa, nearly nine months at Lake Tanganyika, and less than a fortnight on the west of the Victoria Nyanza His object was to make as complete a collection as possible of the plants and animals, especially from Lake Tanganyika with the view of solving the "Tanganyika problem" whether the fauna and flora of this lake indicate a former marine connection The flowering plants, fern allies, and Characeæ numbering about forty-five species, were for the most part, well-known and widely distributed forms such as *Najas marina*, species of Potamogeton *Pistia Stratiotes Ceratophyllum demersum, Myriophyllum spicatum, Jussiaea repens, Trapa natans* and *Chara zeylanica* with others restricted to tropical or subtropical Africa such as Ottelia *Boottia scabra*, and species of Utricularia In no case was there any suggestion of marine conditions either past or present, in the representatives of the flora

The plankton and fresh-water algæ, of which an account was given by Mr G S West, yielded remarkably rich results due partly, no doubt, to the paucity of our previous knowledge of the microscopic flora of these lakes, especially in the case of Tanganyika Mr West's list contains about 400 species, a large proportion of which are new, including one new genus of Palmellaceæ A few species from Tanganyika showed a striking affinity with marine forms, indicating that at some period the water of this lake had a considerable degree of salinity, but as Dr Cunnington explained, this did not involve a previous marine connection but might be explained by an increase in saline matter in the water due to the damming of the outlet from the lake This damming was perhaps a periodical occurrence, since Stanley, thirty years ago, described the lake as with no outlet, while a few years later Mr Hore, visiting the same spot as Stanley, found the water rushing through the present outlet towards the Congo —A new and abnormal species of Rhipicephalus W F **Cooper** and L E **Robinson.**

January 17 —Prof W A Herdman, F R S , president, in the chair —*Platanthera chlorantha*, Custor, var *tricalcarata* W Botting **Hemsley** The specimen had been found at Pax Sherborne, Dorset by Miss D R Wilson who sent it to Kew, the ten flowers on the spike were modified as described the paired sepals were spurred, and the lip was uppermost that is, the usual twist of the ovary was absent —Acanthaceæ of insular Malaya the late Mr C B **Clarke** This paper was complementary to a similar one, drawn up for the "Materials for a Flora of the Malay Peninsula" now in course of issue by Sir George King and Mr Gamble The paper includes in its area Malaya exclusive of the peninsula itself —An isopod, *Tachaea spongillicola* n sp of the family Corallanidæ, distinguished from its near ally, the marine *Tachaea crassipes* Schiodte and Meinert, by having the terminal joint of the maxillipeds, not smaller, but considerably larger than either of the two preceding joints Rev T R R **Stebbing** —A new British terrestrial isopod A **Patience.** The species in question, which Mr Patience has named *Trichoniscus Stebbingi*, n sp , was first obtained by him in a field near Alexandra Park, Glasgow in company with *T pygmaeus* Sars and *Trichoniscoides albidus* (Budde-Lund), and subsequently in some numbers in one of the propagating houses of the Glasgow Botanic Gardens

Society of Chemical Industry January 7 —Mr R J Friswell in the chair —The sixth International Congress of Applied Chemistry at Rome W F **Reid** (see NATURE vol lxxiv , p 65, May 17 1906) —The determination of higher alcohols in spirits, part 1, the "ester-iodine" method C H **Bedford** and R I **Jenks.** The authors point out the defects of the Allen-Marquardt process for the estimation of higher alcohols in potable spirits Dunstan and Dymond (*Pharm Journ* , 3 xix , 741) have shown how to determine organic nitrites by allowing them to act on an acid solution of potassium iodide in a flask void of oxygen and then titrating the liberated iodine with thiosulphate This serves as the basis of the authors' method Details are given for the extraction and esterification of the total higher alcohols, and the subsequent decomposition of the esters by iodine Beckmann's method of esterification (one part of sodium nitrite and two parts of acid potassium sulphate powdered together) is employed Results are given showing the accuracy of the method An analysis can easily be carried out in a day —The determination of indigotin in commercial indigo C **Bergtheil** and R V **Briggs** The authors criticise Bloxam's method for the determination of indigotin (Journ Soc Chem Ind , 1906, xxv , 735), and point out that low results are obtained The error is due to the factor on which the calculation is based and the loss of indigotin which invariably occurs in salting out and filtering the sulphonic acid salt A series of determinations was carried out by the authors' method (Journ Soc Chem Ind , 1906, xxv , 729) and by Bloxam's method (*loc cit*), and they are of opinion that the latter does not appear to be trustworthy either in application to pure indigotin or to commercial indigo The method is cumbersome and inapplicable to work in the indigo districts of India owing to the low temperature at which it is necessary to work, and the large amount of ice required for this purpose.

Geological Society, January 9 —Sir Archibald Geikie, Sec R S , president, in the chair —The Cretaceous formation of Bahia (Brazil) and the vertebrate fossils contained therein J **Mawson** and Dr A S **Woodward.** This paper relates to a series of estuarine and fresh-water deposits originally described to the Geological Society by the late Samuel Allport in 1859 The results of thirty years' collecting of fossils are summarised, and the distribution of the formation, so far as determined, is marked on a map The strata are disturbed by numerous dislocations and discordant dips, and no regular succession of zones or horizons can be discovered All the more important vertebrate fossils collected are now in the British Museum (Natural History) From these a few remains of new species are selected for special description A mandibular symphysis of a very large crocodile, with a long garial-like snout, belongs to one of the Goniopholidæ Some dinosaurian vertebræ seem to belong to the iguanodont group A large fish-skull represents a new genus allied to Macropoma, and indicates a species five or six times as large as any cœlacanth previously discovered The discussion of a complete list of the fossil Vertebrata proves that the formation is of Cretaceous age, and suggests that it may be Lower Cretaceous, as supposed by Hartt —A new dinosaurian reptile from the Trias of Lossiemouth, Elgin Dr A S **Woodward** Mr William Taylor of Elgin, recently discovered two skeletons of a small new reptile in the Triassic sandstone of Lossiemouth Two imperfect skeletons of the same species are also shown on a slab of the same sandstone in the British Museum (Natural History) The head and trunk measure only 4 inches in length, but there is a very long and slender tail The head is relatively large, and resembles that of Ornithosuchus in many respects but the fossils do not exhibit any teeth The author concludes that this must have been a running or leaping reptile, and that it represents a new genus of Dinosauria related to the American Triassic Hallopus

Faraday Society January 15 —Sir Joseph Swan, F R S , past-president in the chair —The application of the electron theory to electrolysis F E **Fournier d'Albe.** The electron theory, by postulating the existence of material carriers of all electric charges, is practically an extension of the ionic theory to solids and gases, and it thus brings into line the processes of metallic and electrolytic conduction The author directed attention to the importance of making further studies of mobility and quantitative determinations of the hydration of ions as a preliminary for determining the sizes of the ions and of their actual constitutions based on kinetic principles

Royal Meteorological Society, January 16 – Annual general meeting —Presidential address, weather in war time R **Bentley** The address showed how on more than three hundred occasions the course of history was greatly influenced by weather conditions

EDINBURGH

Royal Society, December 17, 1906 —Prof Gray, vice president, in the chair —The hæmo-renal salt index as a test of the functional efficiency of the kidney Dr Dawson **Turner** The hæmo-renal salt index is defined to be the ratio of the electrical resistance of the blood to the electrical resistance of the urine In health this ratio should be 4 or 5 When the index increases it indicates that the blood contains fewer salts or is richer in corpuscles, or that the urine contains more salts, or that all these changes exist together With low resistance of the urine the functional activity of the kidneys is increased Several medical cases were referred to, and it was pointed out that the method would probably prove to be of great value in surgery With the apparatus which had been devised the measurements could be rapidly made on very small quantities of both blood and urine The method was another example of the application of precise scientific measurement to clinical medicine and surgery, and showed the importance of a medical student being trained in medical experimental physics —Relation between magnetisation and electric conductivity in nickel at high temperatures Dr

C. G. Knott. The point of special interest was the manner in which the increase of conductance due to the application of a field transverse to the direction in which the conductivity was being measured first diminished steadily with rise of temperature until it reached a minimum at about 280° C, then rose abruptly to a maximum at 310° C, and finally fell off to zero at 350° C.—The relation between normal take-up or contraction and yarn-number for the same degree of twist in twisted threads: T. Oliver. In a former paper the relation between the take-up in the second twisting of a two-ply yarn and the amounts of first and second twistings was studied experimentally and analytically. The present paper considered the relation when, with the same twistings, different sizes of thread were used. This at once brings in the "yarn number," which cannot be taken in the same way as wires are gauged, but must depend on the relation of length to weight. Experimental results were obtained for two distinct sets of cases, according as the component threads were of the same diameter or of different diameters. Formulæ were established with which the experimental results were compared, and considering the complexities of the problem the comparison was sufficiently satisfactory.—The superposition of mechanical vibrations (electric oscillations) upon the magnetisation, and conversely, in iron, steel, and nickel, part ii: J. Russell. In this continuation of a difficult piece of work the author discussed the discrepancy between his former results and those obtained by Dr. Eccles, and expressed his opinion that the latter investigator had not taken sufficient precaution in reducing the metal to exactly the same magnetic state before each experiment. It is only by means of a succession of gradually diminishing reversals that we can be certain that the magnetised substance is brought back to a definite condition time after time.

January 7.—Prof. Crum Brown, vice-president, in the chair.—Notes on aboriginals of the northern territory of South Australia: Dr. W. Ramsay Smith. The paper contained a detailed discussion of several of the peculiar rites and customs of the Australian aborigines, such as the scars on shoulder, breast, arms and abdomen. Evidence was adduced that these scars had definite signification implying, perhaps, the number of children borne, the number still alive, the death of a near relative, or the widowhood of the individual bearing the scars. Other points taken up were the character of the dentition, the grasping power of the great toe, the rite of sub-incision, and the interpretation of the carved message sticks.—Exhibition of the skeletons of monkeys showing effects produced by improper feeding: Prof. D. J. Cunningham. The skeletons and skulls in the university anatomical museum frequently showed abnormalities, such as excessive bending or softening or a certain roughness on the surface. Many of the specimens had been purchased from travelling menageries, and there seemed to be little doubt that the effects were due to improper feeding and bad ventilation.—The partition of heat energy in the molecules of gases: Dr. P. Ehrenfest.—Vibrating systems which are not subject to the Maxwell-Boltmann law. Second paper: Dr. Wm. Peddie. These two papers were sequels to Dr. Peddie's first paper, certain results in which were criticised and to some extent modified. Dr. Peddie also gave a purely mathematical discussion of the problem in distribution devised by Lord Kelvin as a test-case for the proof or disproof of the Boltzmann-Maxwell doctrine. This was the problem of the motion of a particle within a circular region the rim of which consisted of a series of semi-circular corrugations. Although in the long run the time integral of the kinetic energy of the component motion parallel to any fixed direction would in this case be the same for all directions, the time integrals of the two components, radial and transversal, according to polar coordinates, would not be the same, thus disproving the Boltzmann-Maxwell law.—Note on cases of contour zones of molecular arrangement from surface disturbance: Dr. James Hunter. When a piece of fine-grained stone which has been used for polishing splits, an inspection of the new surfaces shows a distinct zone running approximately parallel to the cylindrical surface of the stone disc. Outward towards the circumference, the texture of the stone is radial, suggesting radial arrangements of the molecules, while inside there is no trace of this arrangement. Similar contours appear in other cases, such as when glass is cut by a diamond or by the cutting-wheel. It was interesting to observe how different the patterns of the markings were in these two instances.

PARIS

Academy of Sciences, January 21.—M. Henri Becquerel in the chair.—A proposed system of classification for the bibliography of subjects bearing on seismology: G. Bigourdan.—An expedition of Commandant Chaves in Africa: Prince Albert I of Monaco. An outline of the magnetic work done on this expedition, and an account of the comparison of the instruments used with those at Cape Town.—The resistance and elastic equilibrium of tubes round which an elastic wire is wound: A. Jacob.—Communications were received from M. Milan Stefanik and M. Janssen stating that observations of the solar eclipse of January 14 had been prevented by clouds.—The approximation of functions by limited trigonometrical series: Maurice Fréchet.—Helices of propulsion: P. Tsoucalas and J. Vlahavas.—Propulsive helices: F. Ferrier.—Measurements of the Zeeman effect on the blue lines of zinc: P. Weiss and A. Cotton. The lines studied were the three 4810.71, 4722.26 and 4680.33, in a magnetic field the strength of which varied between 25,500 and 36,000 Gauss. Contrary to the results of Reese and Kent, the distance between the two magnetic components was found to be proportional to the intensity of the field, the results being in complete accord with the simple relations which Runge and Paschen have discovered.—The modifications which the absorption bands of tysonite undergo in a magnetic field: Jean Becquerel.—The preparation of pure helium by filtration of gases from cleveite through a wall of silica: Adrien Jaquerod and L. Louis Perrot. In a previous paper the authors have shown that the helium thermometer with a fused quartz bulb was useless on account of the readiness with which the gas penetrated the walls at a high temperature. On the other hand, it was found that silica is quite impermeable to all other gases at about 1000° C., with the exception of hydrogen and possibly carbon monoxide. In the present paper application is made of these facts to the preparation of pure helium from cleveite. Using a bulb of 42 c.c. capacity the method described gives a yield of about 1 c.c. of pure helium per hour. The gas obtained in this way was found by spectroscopic examination to be free from nitrogen, the only gas present besides helium being a minute trace of hydrogen, possibly derived from the electrodes of the tube.—The absence of nutrition in the formation of the artificial plants of Leduc: MM. Charrin and Goupil. Experiments are described showing that the word nutrition is misapplied when used in connection with these phenomena.—The mechanism of the synthesis of some quinoline derivatives: L. J. Simon.—The conditions of stability of the carbamines: H. Guillemard.—The synthesis of derivatives of cyclohexane: 3.3-dimethyl- and 3.3.6-trimethyl-cyclohexanones: G. Blanc. The author has described in an earlier paper the synthetical preparation of $\beta\beta$-dimethyl- and $\beta\beta\epsilon$-trimethyl-pimelic acids. These acids are converted into the corresponding anhydrides by treatment with acetic anhydride, and these, slowly distilled under ordinary atmospheric pressure, split up quantitatively into carbon dioxide and the cyclohexanone.—The synthesis of natural erythrite: M. Lespieau. The preparation of an inactive erythrolactone has been described in an earlier paper; this lactone treated with brucine and the product submitted to fractional crystallisation, has yielded a lævorotatory lactone and natural erythrite.—The symbiosis of the fig and blastophage: Leclerc du Sablon.—The presence of formaldehyde in green plants: G. Kimpflin. As a reagent for detecting formaldehyde, the author uses methylpara-amidometa-cresol, and shows that the reaction is distinctive. This reagent has the advantage that it does not destroy vegetable tissue.—The active substances of *Tephrosia Vogelii*: M. Hanriot. By methods given in detail the author has isolated a volatile liquid, tephrosal, of the composition $C_{16}H_{14}O$, and a crystalline substance, tephrosine, of the formula $C_{31}H_{26}O_{10}$.—The formation and distribution of an

essential oil in a living plant Eug **Charabot** and G **Laloue.** An examination of the plant *Artemisia absynthium* —The pharmacodynamical action of a new alkaloid contained in the root of fresh valerian J **Chevalier.**—The formation of the skeleton in some of the hexacorals Armand **Krempf** —The part belonging to the anastomotic branch of the spinal in the physiological properties of the pneumo-gastric or pneumo-spinal nerve F X Lesbre and F **Maignon** —Some new experiments concerning the pathology of pulmonary anthracosis G **Kuss** and E **Lobstein.** Further experiments bearing on the criticisms of MM Calmette, Grysez, and Vansteenberghe The conclusions drawn from this work are that ordinary pulmonary anthracosis as arising in ordinary life, is produced by inhalation and not by deglutition —The evolution of the Cerithidæ in the Middle and Upper Eocene of the Paris basin Jean **Boussac.**

GÖTTINGEN

Royal Society of Sciences —The *Nachrichten* (physico-mathematical section) parts iii and iv for 1906, contains the following memoirs communicated to the society —

May 12 —The motion of an electron under the influence of a longitudinally directed force Paul **Hertz.**

March 31 —Physics without apparatus, attraction and repulsion of unelectrified bodies Electrical experiments with a polished table surface W **Holtz.**

May 5 —The imaginary zeros of the hypergeometric function A **Hurwitz.**

June 16 —Calorimetric studies, i, specific heats of pure alcohol, and of mixtures of alcohol and water F **Bose**

July 28 —Calorimetric studies, ii, thermal anomalies in alcoholic mixtures, iii, relations between the foregoing results (i and ii) F **Bose** —Seismic records in Göttingen during 1905 G **Angenheister**

May 19 —A characteristic property of the *Klassenkörper* (Abelian functions) Ph **Furtwängler**

October 27 —Statistical review of the local and remote earth tremors recorded at the Samoa Observatory during 1905 F **Linke**

July 28 —Principles of a general theory of linear integral equations D **Hilbert.**

DIARY OF SOCIETIES.

THURSDAY, JANUARY 31

ROYAL SOCIETY, at 4 30 —On the Two Spectra of the Elements as Evidence of the Composite Nature of the Atoms Prof W N Hartley F R S —On the Explosion of Pure Electrolytic Gas Prof H B Dixon F R S, and L Bradshaw —The Firing of Gaseous Mixtures by Compression L Bradshaw —A Recording Calorimeter for Explosions Prof B Hopkinson.—On the Discharge of Negative Electricity from Hot Calcium Dr F Horton

ROYAL INSTITUTION, at 3 —Standards of Weights and Measures Major Percy A Macmahon, F R S

FRIDAY FEBRUARY 1

ROYAL INSTITUTION at 9 —The Methods of Combating the Bacteria of Disease in the Interior of the Organism Sir Almroth E Wright, F R S

GEOLOGISTS ASSOCIATION at 7 30 —Presidential Address On the Constitution and Management of Scientific Societies

MONDAY FEBRUARY 4

LONDON INSTITUTION at 5.—Through Savage Europe Harry de Windt

SOCIETY OF ARTS, at 8 —Gold Mining and Gold Production Lode Mining Prof J W Gregory F R S

SOCIETY OF CHEMICAL INDUSTRY at 8 —(1) The Chemical Composition of some Motor Tyre Rubbers (2) On the Composition of some New Crude Rubbers Dr P Schidrowitz and F Kaye

VICTORIA INSTITUTE, at 4 30.—The Bible Pedigree of the Nations M L Rouse

TUESDAY FEBRUARY 5

ROYAL INSTITUTION at 3.—Survivals from the Past in the Plant World Prof A C Seward F R S

INSTITUTION OF CIVIL ENGINEERS, at 8 —Modern Motor Vehicles Col R E B Crompton C B

ZOOLOGICAL SOCIETY, at 8 30 —On the Fœtus of the Giraffe Prof E Ray Lankester F R S —On New or Rare Cumacea from the Collection of the Copenhagen Museum Part 1 Dr W T Calman —Description of a New Amazonian Tree Frog with Peculiar Breeding Habits Dr E A Goeldi

WEDNESDAY, FEBRUARY 6

SOCIETY OF PUBLIC ANALYSTS at 8 15 —Annual General Meeting Presidential Address —(1) Mineral Acids in Vinegar (2) The Composition of English Fermentation Vinegar F D Ratcliff —The Detection of Cane Sugar in Milk W H Anderson

SOCIETY OF ARTS at 8 —The Principles and Practice of Insurance, and their Modern Developments T E Young

GEOLOGICAL SOCIETY, at 8 —Note on the Cervical Vertebra of a Zeuglodon from the Barton Clay of Barton Cliff (Hampshire) Dr C W Andrews, F R S.—On the Origin and Age of the Plateaus around Torquay (South Devon) A J Jukes-Browne.

ENTOMOLOGICAL SOCIETY, at 8 —Notes on the Indo-Australian Papilionidæ Percy I Lathy

THURSDAY FEBRUARY 7.

ROYAL SOCIETY, at 4 30.—*Probable Papers*: The Influence of Increased Barometric Pressure on Man, No 3, The Possibility of Oxygen Bubbles being set free in the Body Leonard Hill, F.R S, and M Greenwood, jun.—On the Combining Properties of the Opsonin of an Immune Serum: Prof R Muir and W B. M. Martin —Experiments made to determine the Condition under which "Specific" Bacteria derived from Sewage may be present in the Air of Ventilating Pipes, Drains, Inspection Chambers, and Sewers Major W H Horrocks, R A M.C —Observations on the Life-History of Leucocytes, Part ii, On the Origin of the Granules C E. Walker

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures Major P A Macmahon, F R S

LINNEAN SOCIETY, at 8 —*Papers* New Plants from Malaya Dr Otto Stapf —Tertiary Foraminifera of Victoria the Balcombian Deposits of Port Phillip F, Chapman —*Exhibitions* Specimens of *Chara ornithopoda* H and J Groves.—Some Observations of Climbing Plants (with lantern-slides) Rev John Gerard —Herbarium formed by A. Ruperti, 1698–1700 W. Ross Smith

CHEMICAL SOCIETY, at 8 30.—On the Rapid Electroanalytical Deposition and Separation of Metals, Part i, The Metals of the Silver and Copper Groups and Zinc H J S Sand —The Alkaloids of Ergot G Barger and F H Carr —Influence of Substitution on the Formation of Diazo-amines and Amino-azo-compounds, Part vi, the Partially Methylated 4.6-Diamino-*m*-xylenes G T Morgan and F M G Micklethwait —(1) The Reduction of Hydroxylaminodihydroumbellulone Oxime, (2) The Constitution of Umbellulone, Part ii, the Reduction of Umbellulonic Acid F Tutin —Studies on Optically Active Carbimides, Part v, The Aryl Esters and the Amides of 1 Menthylcarbamic Acid R H. Pickard and W Oswald —Some Constituents of Natural Indigo Part i A G Perkin and W P Bloxam —The Occurrence of Isatin in some Samples of Java Indigo A G Perkin —(1) On the Absorption Spectra of Benzoic Acid, the Benzoates and Benzamide, (2) The Absorption Spectra of Phthalic, *iso*Phthalic and Terephthalic Acids Phthalic Anhydride and Phthalimide W N Hartley and E P Hedley,—$\alpha\alpha\gamma$-Trimethyl and $\alpha\alpha\gamma\gamma$ Tetramethyl-tricarballylic Acids and $\alpha\Delta$ Dimethyl-butane $\alpha\beta\Delta$ Tricarboxylic Acid H Henstock and C. H, G Sprankling.—A Reaction of Certain Colouring Matters of the Oxazine Series J F Thorpe

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Investigations on Light Standards and the Present Condition of the High Voltage Glow Lamp C C Paterson (Conclusion of Discussion).—Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps using Alternating Currents H F Haworth, T H Matthewman, and D H Ogley

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THURSDAY, FEBRUARY 7, 1907

ANATOMY OF THE HORSE

(1) *Surgical Anatomy of the Horse* Part I By John T Share-Jones Pp xii+159, with 33 plates (London Williams and Norgate, 1906)

(2) *Le Cheval* By H-J Gobert Pp viii+412, with 80 figures (Paris Baillière et Fils, 1907) Price 7 francs

(1) SINCE 1832, when William Percival produced the first work exclusively devoted to the anatomy of the horse, considerable advances have been made in the methods of teaching veterinary anatomy, but it cannot be said that the production of anatomical literature has been correspondingly abundant in this country The veterinarian has not had his time too heavily taxed by the examination of frequent new publications Consequently, he will welcome with all the more interest the first part of a "Surgical Anatomy of the Horse," from the pen of Mr J T Share-Jones, of the Liverpool Veterinary School The present volume deals with the anatomy of the head and neck as applied to the surgery of these regions, and it is to be followed by further parts devoted, in like manner, to the rest of the body

The author, while admitting the psychological value of anatomy as a means of developing the faculty of observation, "is impelled to the conclusion that the subject is primarily and fundamentally utilitarian, and that the teaching of it should always be in association with the subject of surgery" Such an expression of opinion leads to the conclusion that the author is a surgeon at heart, and not an anatomist as the term is generally understood nowadays The modern anatomist has become much more a student of the scientific and comparative side of his subject than of its surgical or—to quote the author—utilitarian aspect Surgery occupying the first place in his affections, and anatomy coming second, Mr Share-Jones is clearly the proper person to write a "Surgical Anatomy" But even a surgeon, in producing such a work, should bear in mind that "anatomy" is the substantive, and "surgical" not more than an adjective The work before us is rather more surgical and much less anatomical than are most standard publications bearing the same title The various operations performed on the regions discussed are described at some length, with the consequent curtailment of the space allotted to topography The result is not satisfactory from an anatomical point of view for it means that the descriptions, as given, are of only moderate value to the student or practitioner to whom the structures have been made familiar by dissection, and of less value to the student entering upon a course of practical anatomy

Certain statements, moreover, are of doubtful clarity and accuracy For example, in speaking of the rudimentary first premolar teeth of the horse (referred to as "wolf's teeth") it is said that "each is developed in the same dental groove as the corresponding row of molars, and is probably due to the displacement of a supernumerary dental germ in the groove" This scarcely squares with phylogeny Again, the short section on the development of the teeth might have been omitted with profit, for from it the reader will gather little accurate knowledge of the process To justify this assertion we may quote the first part of the section "The first stage in the development of a tooth is the appearance in a groove in one of the maxillary bones of a little closed sac, which is called the dental follicle The membranous wall of the follicle encloses a papilla, which is at a later stage termed the dental pulp, and from which the dentine is secreted The enamel is developed from a special layer of epithelium which covers the upper aspect of the pulp and which is called the enamel organ As the dentine is formed from the superficial cells of the pulp, it becomes deposited between the latter and the follicular wall From the superficial cells the tubular processes of the dentine are thrown out, but the intertubular substance is secreted by the deeper layer of cells This latter substance contains the earthy salts"

The prefatory statement that "an endeavour has been made to illustrate graphically wherever possible, and to reduce the written matter to a minimum" leads to a close examination of the illustrations Of these it may be said that they are of unequal merit, and few of them will compare favourably with illustrations in Continental works on topographical anatomy In Plate xii we notice a rather glaring inaccuracy in regard to the teeth, which leads us to suspect that the drawing was not made from an actual section It is not stated at what level the section was supposed to have been made and it is therefore not easy to form a correct judgment of its truth to nature, but surely there is something wrong with the mylo-hyoid and digastricus muscles?

That, in spite of the blemishes to which we have referred the work will fill a gap in veterinary literature is undoubted, inasmuch as there is no other book in the English language which claims to be a surgical anatomy of the horse That it will be of service to the student and practitioner may also be taken for granted The publisher and printer deserve praise for the manner in which they have turned out the book

(2) M Gobert has endeavoured, with a considerable measure of success to provide a short popular treatise on the organisation maintenance in health and utilisation of the horse for the use of those who desire to possess a greater knowledge of the animal than can be acquired through the more customary channels From the nature and scope of the book, it is not expected that the section which deals with the anatomy of the horse will be other than extremely elementary For the same reason it is unnecessary to submit it to elaborate criticism The section has many merits Its facts are set forth in clear terms shorn, as far as possible, of technicalities At the same time the author has fallen into the error so frequently made by writers of similar popular works,

of including details which cannot possibly be thoroughly understood by the ordinary lay reader For example, a certain amount of description of microscopic structure is included, which is either too much or too little It would probably have been better omitted entirely Again, a short list of muscles, such as is given on p 14, cannot be of any value whatever to the reader for whom the book is intended Most of the illustrations are good, but some of them—notably Fig 2—are far from clear

The compilation has much to commend it, and at the same time has many of the defects which appear to be inseparable from books of its kind

HIGHER EDUCATION IN GERMANY

The German Universities and University Study By Friedrich Paulsen Authorised translation by Frank Thilly and William Elwang Pp xvi+451 (London Longmans, Green and Co, 1906) Price 15s net

THIS excellent translation of Prof Paulsen's celebrated book on the German universities will be welcomed by many readers interested in the question of university education who have not the time or opportunity to read it in the original, the book is not merely an account of German universities but treats the general subject of higher education in its relation to the advancement of knowledge and to the life of the community on a broad and philosophic basis

The peculiar value which seems to us to attach to this work is due to this very breadth of view the author is concerned, not with pressing the importance of some particular aspect of university life or of the claims of a particular branch of learning, an attitude which reduces so much of the writing on English education to mere sectional pamphleteering, but with the presentation of the historical development of university life, and especially with the function of the university under modern conditions, and with the problems which these conditions bring in their train It is probably true that it is easier to be dispassionate when one is contented, and Prof Paulsen is, on the whole, contented with the German universities and what they have done and are doing for the culture of the German people, but his contentment goes deeper, he is satisfied that the universities in Germany owe their hold over the intellectual life of the people to their unreserved acceptation of the scientific spirit, that is to say, the spirit of inquiry and free investigation into all the departments of learning The university is defended and vindicated by the author primarily as an institution for research and the advancement of knowledge, and secondarily as a place of education, secondarily, not from the mistaken notion that education is considered less important than the expansion of the limits of knowledge, for we may remember that the only way of entering the learned professions, including schoolmastering and the Civil Service, in Germany is through the university, but because the most important part of a university education is considered to be the actual contact with the fountains of knowledge and the acquisition of a capacity to grapple with original sources and to form an independent opinion The system undoubtedly has its dangers, especially the danger of over-specialisation and the fault of encouraging students to undertake scientific investigation who would be more fittingly employed in practical affairs, but the author considers that the universities have gained and retained their influence by standing in the van of new ideas as the home for investigation, instead of handing on traditional learning, tardily and painfully modified from without by the changes of the times

It is interesting to note the parting of the ways between the French and German universities at the beginning of the nineteenth century, the Napoleonic era converted the French universities into technical schools for the professions and banished the pursuit of learning to the academies, while at that very time Humboldt founded the modern University of Berlin in direct opposition as an institution of free learning and broad education, and to that ideal all the German universities conformed

There can hardly be any doubt as to which ideal has proved most fruitful, but the plan is apparently now advocated in some quarters in Germany of attempting to combine the technical schools in a closer alliance with the universities, and Prof Paulsen has sufficient faith in the innate Teutonic love of learning to believe that science would not thereby be strangled in the grasp of a short-sighted utilitarianism This, of course especially applies to the natural sciences, but in all the faculties there have grown up side by side with the universities, technical academies of art, military science, commerce, jurisprudence, and the like, which train an increasing number of students

"All public institutions of learning," remarks Prof Paulsen, "are called into existence by social needs" and it is interesting to follow the historical evolution of the university from this point of view as it is skilfully delineated by the author The mediæval universities seem really to have satisfied our modern ideals to an extent which is perhaps not commonly suspected, and will probably never be re-attained, they were, in the first place, cosmopolitan, and not under the restrictions of a particular country or Government, and they were the true repositories of the learning of their times With the coming of the Renaissance, and later of the Reformation, a change of the greatest importance occurred, from being cosmopolitan they became strictly territorial, from being free they became the *instrumenta dominationis* of the particular Government under which they happened to be

In consequence, the faculty of law was chiefly fostered to the detriment of all others, and towards the end of the seventeenth century in Germany university life was at a very low ebb With the foundations of Halle and Gottingen in the eighteenth

century a revival began, which Prof Paulsen traces largely to the rise of the philosophical faculty from servitude as *ancilla theologiae* to the leadership, though it doubtless corresponded with the awakening of the general intellectual life of the country inaugurated by Klopstock and Lessing

But the old freedom of the universities in Germany was necessarily never revived in its completion, and the position of the university as a State institution dependent to a large degree in its internal administration on the Government of the country in which it is situated leads to anomalies even now which Englishmen will not readily understand, though the real interference with freedom may be less than it seems Thus the government of the university, even extending to the syllabus of studies in a particular faculty, is potentially, and sometimes actually, under the control of a Minister of Education, while the ordinary professors are appointed by the Sovereign of their country and the extraordinary by the Minister of Education, and it appears from the statistics quoted by Prof Paulsen that in a fair proportion of cases the appointment runs counter to the recommendation of the faculties, but our author, ever determined to see both sides of a question, remarks that political and Court intrigues tend to efface the back-stairs politics of the faculties, so that in the end the right man is usually chosen

It follows also from the dependency of the universities on the State that the teachers must hold cautious political views, and even Prof Paulsen has nothing at all to say in favour of the Prussian Ministry which dismissed a privatdocent of physics from his post on the sole ground that he was a social democrat

To choose one more point from a book absorbing throughout in interest, it is instructive to note that the absence of all social life such as is enjoyed at the old English universities does not cause that complete satisfaction which opponents of the system are so keen to insist on, but in several instances boarding-houses are being instituted where students can live in common In the Middle Ages the residential collegiate system was of course universal, and a few colleges were retained long after the system had died out on the Continent for the benefit of the poorer students It can hardly be held that the collegiate system persisted in England for the same purpose

We may sketch the plan of Prof Paulsen's work as follows —in the first book we are given an outline of the historical development of the universities from the Middle Ages down to modern times, and probably nowhere else can so much be learnt on this subject within the compass of about seventy pages the succeeding books are concerned with present-day conditions, the second treating of the relation of the university to the State, to society, and to the Church the third dealing with university teachers and the methods of instruction, the fourth with university life from the student's point of view In the fifth book some special problems connected with the several faculties of theology law, medicine, and philosophy are discussed G S

GEODESY IN THE SCHOOLS

Text-Book on Geodesy and Least Squares Prepared for the Use of Civil Engineering Students By Prof Charles L Crandall Pp x+329 (New York John Wiley and Sons, London Chapman and Hall, Ltd , 1907) Price 12s 6d net

SUCH a treatise offers little scope for originality of treatment or of design The problems connected with triangulation, or with measurement, or with levelling have been considered too frequently and too minutely by experts to permit the introduction of novelty Similarly in the application of the results of measurement to the discussion of the figure of the earth, the author must follow beaten paths and occupy ground that has been thoroughly surveyed His opportunity for exhibiting independence lies rather in the judicious selection of materials, and particularly in determining what should be omitted, that is to say, in considering the requirements of those for whom he is writing Prof Crandall is addressing himself primarily to students of Cornell University, and presumably to those who are beginning the study of the subject and not to professional men engaged in actual work

For a text-book to be used by beginners it might be objected that the author has a little overlaid his treatise with a superfluity of detail The increased attention given in university training to the study of geodesical problems and the determination of the coordinates of a station on the earth's surface is a feature that should be welcomed and encouraged On many grounds it may be urged that the use of instruments in the field is an admirable training, more especially as it affords opportunities for the application of those formulæ which have been acquired from bookwork For this reason one could defend the somewhat lengthy description of instruments here given, their adjustment and method of use, the determination of corrections, &c though at times the author is tempted to indulge in too great detail This error, if it be an error, arises from following too closely the reports and data furnished from the offices of the Coast Survey The danger to be feared is that the minute care and attention to detail necessary in operations extending over a large area, may tend to make the subject repellent to a student whose main object is to gain an intelligent insight into the processes involved But a greater fault appears to be one of omission There is too little, almost nothing concerning the methods of deriving the latitude and longitude of a station And surely such matters are of quite equal importance with the measurement of a base line, and fall as decidedly within the compass of such a work To be able to determine one's position on the earth involves something more practical than a mere college exercise It is information that is frequently needed and may become a matter of great importance

The first few chapters of the book are mainly occupied with the description of the use and adjustment of instruments in the field The next three are devoted to consideration of problems connected with

the figure of the Earth. The mathematical ingenuity exhibited may be interesting, but is familiar. In the form and to the extent in which the several problems are discussed, these chapters scarcely belong to a practical treatise, and do not afford the means of applying the facts that the student has himself derived from the use of instruments.

In the second part, which consists of three chapters, the author serves up the standing dish of least squares. So far as theory is concerned he has followed Chauvenet, and for the practical application to triangulation and conditioned problems the admirable treatise of Wright and Hayford on "The Adjustment of Observations" (see NATURE, vol. lxxiv., p. 148). The book is well illustrated, and there are some useful tables and information given in an appendix, though we scarcely understand the principles upon which the formulæ have been selected. The information throughout is conveyed in a clear and lucid manner, but a little unevenness is sometimes noticeable, as though the author were uncertain of the degree of thoroughness with which the several topics should be treated.

AN AMERICAN TEXT-BOOK OF ENTOMOLOGY.

Entomology, with Special Reference to its Biological and Economic Aspects. By Dr. J. W. Folsom. Pp. vi+485; illustrated. (London: Rebman, Ltd., 1906.) Price 14s. net.

A WORK treating of entomology purely from the bionomic and economic standpoints is a distinct and long-felt want, but it cannot be said that the book under review supplies that want adequately, in spite of its title and a statement in the preface that it "was written in an effort to meet a growing demand for a biological treatment of entomology."

With such admirable and detailed manuals of insect anatomy as Packard's "Text-book of Entomology" and Henneguy's "Les Insectes" already in the field, Dr. Folsom could have safely avoided a treatment of this subject, as it is, his second chapter, entitled "Anatomy and Physiology," occupies nearly one-third of the book, and yet fails to attain the comprehensiveness of the aforementioned manuals. Chapter vii., on the origin of adaptations and of species, might well have been omitted, for it contains nothing that is new and little that is not almost common knowledge; curiously enough, though de Vries's work is discussed, there is no mention of Mendel or his followers.

The inevitable result of these two unnecessary chapters is an unfortunate brevity of treatment in the more useful and interesting sections of the book, and many important phenomena and facts are crowded out altogether. The author may claim (as he does) that his work is "concise," but hardly that it is "comprehensive," since there is no mention of the life-history of Mantidæ, of the eggs of Phasmidæ, of fig-insects, of the cuckoo-spit, of the formation of stick-lac, of the remarkable symbiosis of Acari and bees of the genus Koptorthosoma, of the extraordinary beetles Mormolyce and Hypocephalus. The accounts of parthenogenesis, of phosphorescent insects, and of aquatic insects are lamentably brief, and nothing at all is said of the insects found in caves.

Chapter ix., on insects in relation to other animals, is one of the best in the book; Dr. S. A. Forbes's admirable reports on the insect food of birds and fishes have been largely drawn upon, and deserve the attention directed to them. We have not noticed many errors, but the following need correction in a later edition:—Paraponyx is not the only lepidopterous genus with truly aquatic larvæ (p. 184); *parakleta* should be *paralekta* (p. 216); it is at least doubtful if the mimicry of bees and wasps by species of the genus Volucella can be classed under the heading of aggressive mimicry, it is far more probable that the flies secure immunity from the attacks of vertebrate foes by their resemblance to stinging insects than that this resemblance enables them to enter unobserved the nests of hosts who are quick enough to resist the intrusion of strangers of their own species (p. 235); the blood-parasite conveyed by *Glossina morsitans* is not similar to the malarial parasite (p. 306). The tsetse-fly is cited as the carrier of the blood-parasite in nagana disease, but not of the organism causing sleeping sickness. In the anatomical chapter some reference should be made to the fact that the stomodæal and proctodæal sections of the alimentary canal are lined with chitin, whilst the mesenteron, being of endodermal origin, is not.

The numerous text figures are for the most part excellent, and a goodly proportion are original; special attention may be directed to Figs. 242 and 260, the latter, if a genuine record of an actual occurrence, is a triumph of nature-photography. Fig. 244, illustrating protective mimicry, is unfortunate, for it represents *Eristalis tenax* mimicking a stingless drone-bee. The coloured frontispiece is not only a poor example of what can be done in these days of improved methods of chromolithography and three-colour photography, but also abounds in errors, e.g. Fig. 1, labelled *Heliconius eucrate*, is *Lycorea halia*; Fig. 4 is not *Mechanitis lysimnia*, but *Melinaea ethra*; Fig. 5 is not *Papilio merope* ♂ from South Africa, but *Papilio antinorii* ♀ from Abyssinia; Fig. 8 is *Amauris echeria* from West Africa, not from South Africa; Fig. 10 is not really like any butterfly known to science, but it apparently represents *Papilio merope*, ♀ form *cenea*, though it is labelled *Amauris echeria*, the "model" of the Papilio mimic; Fig. 11, labelled *Papilio merope* ♀, is apparently *P. echerioides* ♀. This gives a total of six errors in eleven figures! It is evident that the author has reproduced the errors occurring in the plates illustrating Weismann's "Evolution Theory," and it is a pity that, in the case of the African butterflies at any rate, he did not consult Trimen's classical paper or the frontispiece to Poulton's "Colours of Animals."

A useful bibliography and a trustworthy and comprehensive index conclude the work. R. S.

OUR BOOK SHELF

Minerals and Metals a Reference-book [of] Useful Data and Tables of Information A condensed compilation from various sources by J G Goesel Pp xiii+287 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1906) Price 12*s* 6*d* net

THE scope of this pocket-book of reference may be best indicated by quoting from the title-page — "Legal, customary, and scientific measurements, geological classification, rock composition, chemistry dry and wet assay, mineralogy, metallurgy, metal founding and plating, hydraulics, water purification; mineral oils, gases, explosives, strength of materials, including woods, their properties, adaptability, and preservation, pigments, gums, and solvents for paints and varnishes, miscellaneous data and receipts" It will thus be seen that the variety of subjects treated is much more extensive than is indicated by the main title, "Minerals and Metals", in fact there is, in a handy form, a vast amount of information which may be of use to mining engineers and others

Books of this kind should, of course, be free from ambiguities and errors, but in the portions which we have specially tested, namely those dealing with minerals and precious stones numerous errors have been detected, quite extraordinary chemical formulæ are given for even common minerals whilst in the spelling of names there are many misprints

The book is clearly printed though not on thin paper, and is well bound in limp leather with rounded corners and gilt edges

Practical Exercises in Chemistry By G C Donington, Senior Science Master in the Leeds Grammar School Pp x+251 (London Macmillan and Co Ltd, 1906) Price 2s 6*d*

MR DONINGTON'S little book derives special interest from the fact that whilst he is a pupil, and a very grateful one, of Prof Armstrong, he has found himself compelled by experience as a science master in a school (and one in which no specially unfavourable conditions prevail) to depart from the practice of leaving the pupils without a text book during their practical lessons This experience is we believe by no means uncommon and it is an advantage that the "felt want" should be supplied by one who naturally strives to conserve as much as he can of the merits of the no text-book system In this object the author has, we think, had good success and his book is likely to take high rank among those which of late years have been written to set forth an elementary course of chemistry for those secondary schools where there is a desire to teach scientific method through the medium of this science

Paradoxes of Nature and Science By Dr W Hampson Pp xv+304 (London Cassell and Co Ltd, 1906) Price 6s

DR HAMPSON proposes to explain to the uninitiated certain scientific "paradoxes" The only possible "explanation" of such paradoxes is attained by showing that the abnormal phenomena are determined by precisely the same laws as the normal phenomena, to "explain" why a balloon rises it is necessary to propound the general principles of gravitational mechanics and to show that it rises for the same reason as a stone falls But Dr Hampson eschews general principles His "explanations" are appeals to prejudices as unscientific as those which gave rise to the appearance of a paradox Even when his arguments are sound they must convey to a reader a wholly untrue idea of scientific method

But they are not always sound Sometimes he wanders far out of his depth, as, for instance, when he seeks to solve the old logical contradiction of Achilles and the tortoise by a reference to the atomic structure of matter He would have done well to restrain his jeers at mathematicians until he had gained some acquaintance with the elements of their science

Seasonal Botany, a Supplementary Text-book By M O'Brien Harris Pp 56 (London Blackie and Son, Ltd, 1906) Price 8*d*

PROBABLY most teaching botanists looking back upon their early experiences when they first found it necessary to draft a syllabus of instruction can recall an attempt to prepare a course adapted to the round of the seasons In the case of pure observational study such a course is profitable but it is the general experience that a seasonal adjustment does not accord with the best morphological or physiological sequence, and this opinion is not modified by the arguments or scheme put forward in the present instance

The seasonal syllabus given in the form of a tabulated scheme, and a number of physiological experiments on very usual lines form the chief contents of the book

French Readings in Science Selections from Scientific and Technical Writers arranged and edited for the Use of Students By de V Payen-Payne Pp vii+230 (London Blackie and Son, Ltd, 1906) Price 3s 6*d*

IGNORANCE of either French or German is a serious handicap to the scientific worker University examining bodies are recognising this need and some such as the University of London demand from candidates for science degrees a knowledge of these languages sufficient to enable them to translate with fair ease and accuracy In making his selection of passages from scientific treatises Mr de Payen-Payne has included some extracts for their modernity and others because of their association with great names in science The compiler is catholic in his tastes and his work should provide students with just the practice they require

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Radium and Geology

THOSE interested in this subject should refer to the paper which appears in the last issue of the *Philosophical Magazine* by Mr A S Eve on the ionisation of the atmosphere over the ocean Mr Eve cites observations and adds others of his own, showing that the ionisation over the ocean is much the same as over the land and points out the difficulty of explaining this in view of the small content of radium in sea-water compared with that in ordinary rocks Possessed as I am with the view that extra terrestrial radio-active dust reaching the earth may account for much of the radium of soils sediments and rocks I cannot but think that Mr Eve's difficulty may find explanation in an extra terrestrial source of supply

Mr Eve also gives some new determinations of the radium in sea water and arrives at results which considerably accentuate the discrepancy which I referred to

in my letter written on January 6 (NATURE, January 24, p 294) On his results a normal river supply of the supposed uranium would in 90,000 years suffice to give the ocean its present radio-activity In short, practically the whole of the uranium has to be accounted for in the sediments Mr Eve perceived the difficulty, and suggests that the sediments are, indeed, its destination I have already referred to the difficulties attending this view

Prof Sollas's contention (p 319) as to the probable original character of the uranium in zircon is, I think, unanswerable I had this fully in view when referring to uranium-bearing minerals in certain rocks In certain rock masses the zircon might be the chief or entire source of radium, but it would appear that this cannot possibly be the case with ordinary granites The analysis made by Mr Strutt of a Cornish granite showed that less than one-ninth only could in this case be so accounted for Mr Strutt directs attention to this Again, Prof Sollas shows by the analysis he cites that this granite was probably unusually rich in zircon In Mr Clarke's last report of analytical work done in the laboratory of the United States Geological Survey (Bulletin No 228) I have found nine granites in which the zirconia is determined The highest percentage was 0 08, and the others ranged from 0 04 downwards to a trace Mr Clarke in Bulletin No 148 speaking of zircon says of igneous rocks generally —"It may rarely be present up to a few tenths of 1 per cent of the rock" He also gives as roughly approximate that the average content of zirconia in igneous rocks is 0 03 This would imply a quantity of zircon adequate to account for barely 4 per cent of the mean radium content of igneous rocks

There are probably other radio-active minerals possessing an original store of uranium but I think Mr Strutt has shown good reason for believing that the chief radium carrier is the mica at least in granites This is a mineral which from its properties would be very likely to absorb and retain substances in solution J JOLY

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The Green Tints of Sunset

THE appearance of a green light at sunset like many other phenomena supposed to have only recently attracted attention, was noticed and commented upon by the ancient Egyptians, and more particularly so because in the clear air of Egypt the tints of sunset are peculiarly distinct

As the sun there descends nearer and nearer to the horizon apparently hastening to disappear behind one of the Libyan hills, as if burying itself in the sand at their base the immensely enlarged flaming disc suddenly becomes for an instant, of a brilliant green colour, and immediately a series of green rays suffuses the sky in many directions well-nigh to the zenith

The same phenomenon appears sometimes at sunrise, but to a smaller extent

According to ancient Egyptian notions of cosmogony, the sun after passing through the western gate into the world of night travelled northward parallel to the Nile until the sixth hour when it commenced to journey southward, having passed to the eastern side of Egypt, and, finally at sunrise came forth by the "Gate of the East"

Now during the nocturnal voyage the solar orb was said to be a disc of Mafkait, which was the title of a green-coloured mineral, and so the sun was considered from sunset to sunrise to be coloured green Sometimes just as the last part of the sun's disc vanishes, its colour changes from green to blue, and so also after it has disappeared the sky near the horizon is often green whilst toward the zenith it is blue This was alluded to in ancient Egyptian writings where sometimes it is said that at sunrise or sunset the sun's rays were of Tehen, a blue metal the title of which is often used in reference to the blue of the sky

In Egyptian thought day was the emblem of life and night that of death and the nocturnal sun being identified with Osiris thus rendered Osiris the god of the dead The setting sun being green therefore Osiris as the nocturnal deity of the dead, was on the monuments and representations of him when referred to as god of the dead painted green, as were other funerary divinities, such as Sekar, the form of the dead Ptah, which was that of a mummy with face and hands coloured green or dark blue. The splendid coffins of the high priests of Ammon, all the decorative tableaus of which are painted, frequently depict the green sun, and deities such as Anubis, god of the funerary journey, Isis, Nephtys, and Osiris are coloured green

It may be interesting, if possible, to decide whether the Egyptians recorded their observation of the green colour at sunset in very early times The late M Groff, who has treated upon this point in the *Bulletin de l'Institut Egyptien*, proved that they did so as early as the fifth dynasty, by showing that a monument of that date delineates the half disc of the setting sun by a figure painted in three successive bands, the two lower, that is to say, those abutting on the horizon—of green, and the upper one of blue

This is not the proper place to discuss the innumerable instances upon Egyptian relics of representations relative to death being coloured green It is undoubtedly the case that the practice arose from the green tints of sunset and sunrise, but it may justifiably be said that in the green-coloured sun disc referred to, which dates 5000 years back, we have the, at present, earliest known human record of an astronomical phenomenon JOSEPH OFFORD

2 Fairfax Road, Bedford Park W, January 29

February and March Meteors.

FEBRUARY and March meteoric showers have never been sufficiently investigated No very special displays have invited abundant observation and, moreover, cold and cloudy weather often prevails at this season Meteors, too, are generally rare, and from these several causes few observers have made persevering efforts to determine the strengths and positions of the radiants visible

In 1877 and 1887, February-March, the writer at Bristol obtained some observations, but they were altogether insufficient to reveal more than a small minority of the meteoric streams of this period Giuseppe Zezioli at Bergamo and Lieut-Colonel G L Tupman in the Mediterranean in 1867 71 effected many valuable observations in February and March, and perhaps their results are the best secured up to the present time

With the earth approaching aphelion, meteors are usually scarce, though there are a number of interesting showers visible and fire-balls are invitingly plentiful But the firmament not having been thoroughly watched during the latter part of the winter season an earnest, persevering and accurate observer has a very promising field before him and may expect to discover more new showers than are likely to reward his vigils under summer and autumnal skies

A number of streams presented during February and March have been already detected but there is a large majority of very feeble systems still awaiting recognition The visible strengths of many showers vary from year to year and there are periodical displays which only occur at long intervals, so that fresh observations are very desirable if our knowledge is to keep pace with the developments frequently occurring

Fireballs are often numerous on about February 10 and March 1–4 Some of the radiant points of ordinary shooting stars recorded at Bristol are —

February		March	
75° + 41°	7–23rd	161° + 58°	end
134 + 67	and in March	166 + 4	beginning
147 + 6		177 + 48	end
158 + 28		190 + 58	middle
175 + 10		196 + 44	
181 + 34	20th	229 + 32	end
204 − 10	13–21st	254 + 55	14th
236 + 11	13–20th	263 + 62	end
263 + 36	20th	270 + 47	middle
332 + 71		316 + 76	

Bristol February 4 W F DENNING

THE DAWN OF MODERN GEOGRAPHY.[1]

MR. C. R. BEAZLEY has now published the third and concluding volume of his important work, "The Dawn of Modern Geography." The third volume is "A History of Exploration and Geographical Science from the Middle of the Thirteenth to the Early Years of the Fifteenth Century (c. A.D. 1260–1420)." A summary of the further progress of geographical knowledge through the time of Prince Henry the Navigator until the rounding of the Cape of Good Hope by Bartholomeu Dias and the voyage of Vasco da Gama at the end of the fifteenth century is appended.

Mr. Beazley's work stops short, therefore, with the voyages of Prince Henry's seamen, with which the dawn of modern geography may well be said to have ripened into full morning. He begins this volume

Genoese Map of the Black Sea. A.D. 1300–5. From "The Dawn of Modern Geography."

with the Polos, and they and Friar Odoric are the central figures of the book. Naturally the narrative tends to group itself around persons, and to become a mere summarised account of their doings; there is little scope for hypothesis or argument except in respect to disputed names and sites. The central facts of the period described are the sea voyages of the Italian sailors, Venetians and Genoese, and the land-journeys of the merchants of the two great republics. Mr. Beazley shows how the sea-enterprise of the Spaniards and Portuguese was started and at first directed by Genoese shipmen, and how knowledge of the Further East was increased by the competition of the *mercatori* of the Ligurian Commonwealth and the City of the Lagoons (which, by the way, he insists on spelling "Lagunes").

Next in importance is the contribution of the Roman Church. Mr. Beazley well emphasises the great importance of the Roman attempt to proselytise the East during the period of Moslem eclipse by the pagan Tartar power. Already, in the preceding period, of which Mr. Beazley's second volume treated, the tendency towards an alliance of Christendom with Heathenesse against the Saracens had come into prominence. The idea of crushing the followers of the False Prophet between the hammer of the Hun and the Frankish anvil had seemed by no means an impossible one. Nor had it seemed unlikely that, with the help of the hordes of Gog and Magog which God had sent forth to do His will, the defeat of the Horns of Hattin might be avenged and the Holy Places restored to Christendom, and why should not the Tartars themselves enter the Christian fold? So Rome sent forth missionaries to the lands of the Ilkhan, and Western bishoprics arose where hitherto only the heretical Armenians, Jacobites, and Nestorians had maintained a faith of doubtful authenticity amid Moslems and Heathen, and the Greek had not been seen for centuries.

Yet of all this endeavour only one tangible result remained: the increased knowledge of the East which the missionaries transmitted to the West. Mutual doubt born of ignorance, mutual incompatibility, prevented Hun and Frank from understanding one another; the precariousness of the way from West to East made communication difficult, and the divisions of the Papacy led the Tartars to place little faith in the power of Christendom to strike anew from the West. Also, a new spirit had arisen in the world; the merchant had come to power side by side with king, knight, and priest. The ideals of the twelfth

[1] "The Dawn of Modern Geography." Vol. iii. By C. Raymond Beazley, M.A., F.R.G.S. Pp. xvi+638. (Oxford: Clarendon Press, 1906.) Price 20s. net.

century were out of date to the men of the thirteenth, especially in the Mediterranean lands, where a republic of merchants had deposed an Emperor and parcelled out his lands, using the cry of the Faith as a cloak for their own ambition. And now neither the merchants of Venice nor those of Genoa would give up their *fondaci* of Alexandria or Cairo, and their lucrative trade with the land of the Soldan, the head-centre of Islâm, at the bidding of a Sanuto in order to restore Jerusalem to the temporal dominion of their faith. The days of the Crusaders were over, the Viking spirit from the North that had impelled the warriors of the Cross to set out to battle with the Paynim followers of Mahound was exhausted, and the men of the later day seemed to love the bezant as much as they venerated the Rood. So the Western Tartars turned to Mohammedanism, the light of the Roman missions in the lands of the Ilkhanate flickered and died out, and the only result of this second phase in the intercourse between the Frankish West and the East was the increased geographical knowledge which in conjunction with the commercial ventures of the time, it brought about. Many ran to and fro, and knowledge was increased.

Many ran far in those days. A journey to Cathay in the thirteenth century must have seemed almost as tremendous as a voyage to the moon would now, and the stories which the travellers brought back of the Chinese must have seemed almost as incredible to their stay-at-home friends as stories of Selenites. Mr. Beazley describes the journeys of the Polos at length, and gives a most interesting epitome of Messer Marco's description of the land of the Great Cham Kublai. The civilised power, in comparison with which Europe was a den of savages, the posts, the banknotes, the great seaport of Zayton (Arabic *Zêtûn*, the modern Amoy), the enormous city of Hangchau, the mighty Khanbalik or Peking, Coleridge's *Xanadu*, the city of Kublai Khan himself, the distant isles of Zipangu or Japan, all must have sounded incredibly wonderful to the Western ear. Yet that the *Milioni* were not liars was proved by many a witness contemporary and following shortly after, Monte Corvino the first Roman Archbishop of Peking, Odoric the Friar, Marignolli the Bishop of Bisignano, and many a simple Genoese trader besides. Of all these Odoric is the most interesting, and seems to have gone furthest. For if Marco Polo visited Szechuen, Yunnan and Burma in his official capacity as a Chinese *Futai* and was the first to acquaint Europe with these regions, the humble missionary brought back knowledge of the Philippines and of the isles beyond Borneo, and was the first European to visit Lhasa. His description, too, of Cathay is second in interest to that of Polo only. And few things in this description are more interesting than his account of how he with the Bishop and other missionaries met the Great Khan (a successor of Kublai) upon the high road and went forth to meet him, the Bishop in cope and mitre, with cross upraised on high, all singing the *Veni Creator*, and how the Emperor raised himself in his palanquin reverently to kiss the sign of salvation, and how Brother Odoric, mindful of the injunction *Non apparebis in conspectu meo vacuus*, tendered to Majesty his humble trencher of apples, whereof the Emperor took one and deigned to eat it.

The Tartar Emperors of the Yuen always treated the Frank Christians with courtesy and showed interest in their religion; it was not until the national Chinese uprising and their replacement by the Ming that Christianity was oppressed, and, very shortly, China was shut to them as completely as two hundred years later Japan was shut to Christian endeavour by the policy of the Tokugawa Shoguns. Just as the Nearer East was barred by the conversion of the Persian Tartars to Islâm, so was the Further East barred by the accession of a national dynasty to the throne of China. No more Franks visited China until the coming of the ships of Portugal and Holland in the sixteenth century. Here also the progress of geographical knowledge was brought to a halt and the promise of the dawn, temporarily at least, belied.

In the opposite field of operations, however, progress, though slower, was never stayed. As was natural, on account of the then superior state of their civilisation to that of the Franks, the Maghrabi Mohammedans were the first to explore the coasts beyond the Pillars of Hercules, and even discovered Madeira and the Canaries. This we know from the voyage of the Eight *Maghrûrîn*, or "Deceived Ones," of Lisbon then (before 1147 A.D., on p. 411 Mr. Beazley says 1154 A.D.) a Moslem city. These worthies set forth in a manner strongly reminiscent of the Wise Men of Gotham, who went to Sea in a Bowl, and found Madeira, which they called, not "Al Ghanam" (as Mr. Beazley has it in his note on p. 532: this would mean "the Sheep"), but *Gezîret al-Ghanam*, "The Isle of Sheep." Afterwards they found the Canaries and eventually got back to Lisbon, where the stay-at-home Gothamites mocked at them for "Maghrûrîn," and probably for *Majnûnîn*, "lunatics," also. However, their isles existed, and in the thirteenth century the Canaries were discovered by the Genoese Lancelot Malocello, from whom Lanzarote took its name.

Mr. Beazley describes the gradual progress of knowledge of these Western isles, the discovery of Madeira by Portuguese under Genoese admiralty, the voyages of Portuguese Catalans, and French beyond Cap Nun to Bojador, and the French expeditions of Béthencourt and Gadifer de la Salle to the Canaries at the end of the fourteenth century which perhaps are the origin of the unsubstantiated French claim to have discovered Guinea long before the sailors of Prince Henry the Navigator. Mr. Beazley is not indistinctly of opinion that the claim of the seventeenth-century writer de Bellefond that Dieppois sailors (we object to Mr. Beazley's "Dieppese") traded with the Guinea coast as early as 1364 is unfounded, to say the least of it. He does not enter much into the question of the MS. of "Mr. William Carter" describing these voyages, which, according to M. Margry, in his "Navigations françaises d'après les documents inédits" (Paris, 1867), was lent to M. de Rosny in 1852 or 1853, and has not since been traced. "Mr. William Carter" is a Frenchman's name for a typical Englishman; it savours of "Miss Mary Smith" or the British "M. Jules Dupont" for a Frenchman. But it should not be difficult to ascertain whether there existed sixty years ago a gentleman bearing this name who would have been likely to have possessed such a manuscript. In any case, however, even if found, it would probably turn out to be of seventeenth-century date, and as worthless for history as de Bellefond's own testimony or the ridiculous rubbish of the Zeni (pp. 456–60) about their "voyages" to the North, in which these heroes confuse Friesland with Iceland, and bestow upon "Frisland" a king called "Zichmni," and so on.

Mr. Beazley gives an interesting sketch of Genoese maritime activity, and shows that the Genoese were the founders of map-making with their wonderfully accurate *portolani*, of which he gives several illustrations, all of them extremely good with the one exception of that of the "Veschonte" map of 1311 (p. 513), which is marred by an ugly band stretched

across it, one would have thought that this could have been avoided

Of English contributors to earth-knowledge at this time there were very few The wonderful Oxford philosopher, Roger Bacon (to whom Alma Mater ought to put up a statue) certainly knew more about the world than most of us are accustomed to think was known in his time, and was remarkably up to date in his information (pp 500–507), but there were no others like him, nor were any of our sailors or chapmen discoverers like the men of Genoa or Venice They were pirates who could gain victories over "Espagnols-sur-mer," but no more Maundeville, alas, is now well known to be a fraud He never existed but in the perverse brain of a Liégois clerk, John à-Beard, who concocted his tales of "Anthropophagi, and men with heads beneath their shoulders," from the true stories of contemporary travellers and many an antick tale drest up anew The supposed English "discovery" of Madeira about 1370 by Machin is probably a myth (p 441) Edward I 's embassy to the Ilkhan Arghun of Persia in 1291–3 under Geoffrey of Langley (Galfridus de Langele) is interesting, but the ambassador went under Genoese guidance, and the English were out of their element in those parts A century later an English constable of Guisnes and his secretary took a jaunt to Egypt and the Holy Places, and were no doubt grievously fleeced by the "magnus" and the "alius drugemannus," and the usual crowd of guides, donkey-boys, and camel-drivers and other demanders of *bakhshish*, much as their descendants might now be But they saw a giraffe, and no doubt that was worth the money The trip cost each pilgrim about 250*l* in modern value Such tours were not uncommon at the time Mr Beazley mentions some Germans; an active knight who ran out to Jerusalem and back in less than the space of one year, and another, William of Boldensel, who travelled in great state, and was so mighty and great that none dared trouble him for impost or dues of any kind wherever he went There was also that amusing pedant the Rector of Sudheim, who consorted with none but kings and nobles the whole time he was away, and when he got back no doubt bored the good folk of his Westphalian village to death with them for the rest of his life

Another German, Schiltberger was no Boldensel or Ludolf, he consorted with kings, it is true, but as their slave Captured at Nicopolis, he was the bondman of Bajazet the Turk, and was by the fortune of battle transferred to the servitude of Timur the Tartar Only after many years of slavery did he escape to his native Germany again His account of the lands in which he lived so many years, from Egypt to Siberia, is naturally of the greatest value, we wish only that he had told us more He was but an unlettered warrior

Of the rule of the second Tartar Empire we have further knowledge from an unexpected source Of Catalan mercantile activity we have already spoken The Castilian rivals of Aragon were no traders, and their first contribution to geographical knowledge was due to an embassy to the East like that of the Englishman Langley, but more than a century after his time In 1403 King Henry of Castille dispatched the noble hidalgo Don Ruy Gonzalez de Clavijo as his envoy to Timur the Tartar, Tamerlane the Great himself and Mr Beazley tells us of the terrible journey of the Spanish envoys, across the uninhabited wastes which the terrible tyrant had made, to his court at Samarkand, of what they saw when at last they got there, and how they left on their return shortly before the conqueror set out on his endeavour to rival Genghis and conquer China, only to die a few stages out of his capital (1405)

In Spain at this time the Moslem kingdom of Granada still existed, shorn of its ancient glory both in war and in science But Moslems still contributed to the increase of geographical knowledge, and one, from the neighbouring Morocco, was second to none as a traveller and recorder of his travels This was the wonderful Shêkh Ibn Batûta of Fez, who in the fourteenth century traversed the greater part of the known world, from Peking to Timbuktu, and wrote an account of his travels which, as might indeed have been expected, shows far greater intelligence than most Frankish records of his time We wish that Mr Beazley had written more about the Moslem geographers Yakut is dismissed in three lines (p 534), Edrisi, in spite of his relations with the Franks of Sicily, has but two pages It is not enough

Space forbids further account of the interesting things in Mr Beazley's last volume In it there are singularly few misprints, and the author has evidently submitted his Oriental names to the scrutiny of someone familiar with Arabic and Syriac We have no more "Jesus Jabuses" or "Mar Jabalabas" in this volume though "Nujmuddin" for the name of an Egyptian sultan is hardly pretty, let us give this Star of the Faith" his hard Egyptian *gim*, and call him Nigm-ud-din

The long-needed index has appeared in the last volume, and with its completion let us cordially congratulate Mr Beazley on the achievement of his work, which is a credit both to him and to his University

SIR MICHAEL FOSTER, K C B, F R S

FIFTY years ago the science of physiology, as now understood was scarcely recognised It began in England when the early anatomists added an account of the uses or actions of the several muscles, glands, and viscera to the account of their form and structure So in the sixteenth and seventeenth centuries each anatomical description was followed by the word *Usus* True, experiments were practised from the time of Vesalius downward, by Harvey himself, by Redi, and by the Rev Stephen Hales and often with brilliant success The problems of the circulation of spontaneous generation and of blood-pressure in the arteries were solved by these admirable experimenters, but their efforts were isolated Fifty years ago we had in England excellent observers with the microscope, particularly Sharpey and Bowman, but there was no systematic study of the working of the human machine by masters like Johannes Muller, Ludwig and Claude Bernard, and "practical physiology" consisted in little more than examining the tissues under the microscope and exhibiting a few chemical reactions of animal fluids

The first attempt to teach the new physiology in England is due to Dr Gamgee, who translated the fifth edition of Hermann's famous text-book About the same time a scientific physician in London gave up practice for the sake of investigating healthy and morbid functions of plants and animals as well as man, and a few years later a young country surgeon who had already given hostages to fortune by a wife and two children persuaded his father to let him leave Huntingdon and adopt the fortunes of a teacher of physiology Dr Burdon-Sanderson from Edinburgh, and Dr Michael Foster from Huntingdon, taught the one pathology (human animal and vegetable) the other histology and "the use of the microscope" Both were tall in stature and striking

in appearance, both made their mark in the practical application of biology to the health of men and animals, both migrated from University College, London, Sanderson to Oxford, and Foster to Cambridge, in order to introduce the modern science of biology into the curriculum of the older universities, Sanderson died somewhat earlier, Foster has only just been removed.

It is still too early to decide on the extent and permanent value of Foster's work, but some estimate of it may be attempted.

His strongest point was force of character, energy, perseverance, thoroughness. He expected his pupils to work as hard as he did, and to regard scientific investigation as the most honourable and delightful pursuit. He had the rare faculty of discovering talent in pupils and giving it concentration and method. He set them problems to solve, and as soon as they had shown their capacity to work alone, he left them to plant the seed in another virgin soil. Foster's success at Cambridge was remarkable, both in the number of those who took up serious study in the laboratory and in the great eminence achieved by very many. His greatest merit is that, like Ludwig, he created in his disciples the noble ambition to increase knowledge, and was content to see the result and to applaud. Some of his pupils have made themselves a European reputation, others have carried Foster's methods and enthusiasm into botany, pathology, public health, and medicine.

Foster early acquired an excellent style for scientific writing. Probably Huxley's lectures and writings pleased him first, but however Foster's style was acquired, he at last attained the state which Hazlitt asserted (not without reason) he had reached when it was less trouble to write well than to write ill.

The child's "lessons" in physiology were as well composed and expressed as the famous "text-book" (1876) and the "History of Physiology" (1900).[1]

He soon gathered together his first band of disciples, among them Francis Balfour, whose brilliant career was sadly ended by an accident on the Alps, Langley, who succeeded him at Cambridge, Gaskell, Sherrington, Adam Sedgwick, L. E. Shore, F. G. Hopkins—these are only some of the names of men who owed their first step in scientific investigation to Foster's inspiration, and remained his cordial friends to the last.

As soon as he had taught the elements of practical research in physiology he encouraged his pupils to work out their own vein, whether the task first set them was completely finished or not. Whatever other academical differences he encountered, Foster never failed in the support of his old pupils.

Apart from his lectures and his books Foster threw himself heartily into the duties which his position as secretary of the Royal Society entailed. He held the office from 1881 to 1903 under the presidency of Spottiswoode, Huxley, Stokes, Kelvin, Lister, and Huggins. He did much to stimulate interest in the biological side of the society.

Foster was a well-known official of the British Association, and was president at Dover in 1897, when he was made a K.C.B. He spoke only to begin or reinforce the discussion. On the council his influence was powerful, and was never used for private ends. At the annual dinner of the society Foster only spoke at intervals, and the task was always well performed. But his oratory at its best was to be heard at less formal meetings where ready wit and good-natured sallies were appropriate.

After his connection with Cambridge was severed, Foster found fresh occasion for serving science by his election as representative of the University of London in Parliament in succession to Sir John Lubbock, now Lord Avebury. His speeches in the House were few, and chiefly confined to subjects on which he could speak with authority—education, public health, fisheries, scientific experiments on animals, and similar cases of applied knowledge. He spoke slowly and distinctly, with a quiet emphasis which secured attention from both sides of the House. He entered Parliament as a Unionist and a supporter of the Boer War, but he found himself out of sympathy with Mr. Balfour's Government on financial policy and on popular education, he therefore sought first to resign, and afterwards to transfer his seat from the Unionist to the Liberal side. At the General Election he was defeated by a very small majority, and his seat is occupied by Sir Philip Magnus. In connection with his political career must be mentioned the important commissions on which Foster served—that on vaccination, of which the late Lord Herschell was chairman, that on the disposal of sewage, another on fisheries, and, perhaps the most important, one on tuberculosis in animals and man. The final report of this committee was signed by Foster only a few days before his death.

On the day before he was taken ill, at the meeting of the British Science Guild at the Mansion House, he spoke as follows:—"This meeting shows how widely science is entering into our lives, it has interwoven itself with our works, and is more and more guiding our ways. If we could imagine a world without science, we might address to that world the words which Dante addressed to Italy in the Middle Ages. 'Nave senza nocchiero in gran tempesta.' Nothing is more clear than that science is not for men of science alone. We, with our slight efforts, can lift great weights. We are a feeble folk, and if we can effect anything it is by pulling the long end of the lever, and it is because of the length of the lever that we are able to effect anything. Thus, with our slight efforts we can lift great weights at present, and we shall lift heavier and heavier weights in the future if we have the support of the people and the support of the Government bidden by the people. It is for the people to bid the Government, and the present Government perhaps above all other Governments, to help science, for they can give us the opportunities we are asking for to-day."

To Foster's personal charm no description can do justice. To old friends like Prof. Carey Foster or Mr. Coots Trotter he was always the same. On a dredging expedition where he and his mate managed the tackle in the intervals of sea-sickness, in a crowded Italian railway carriage or receiving polyglot professors Foster's voice always announced good humour, good temper, and good nature.

He delighted in his garden, and was said to cultivate physiology when not too busy with a new iris. Next to his own species he delighted in cats and dogs and flying birds. His early life between Huntingdon and Cambridge was one of struggle and his later days, when he had lost his laboratory, were clouded by occasional ill-health, but, on the whole, his strenuous and active life was a happy one, for it exercised his great and varied abilities for worthy objects. He was a man greatly beloved, and he has left a deep memorial in the hearts of all who knew him best.

The funeral of Sir Michael Foster took place at Huntingdon on Saturday, among those present at the graveside being Lady Foster, Dr. Michael G. Foster, Dr. R. Bradford, Sir Thomas Barlow, Dr. Pye Smith, Mr. Horace Darwin, Dr. Gaskell, Prof. Langley and Prof. Sherrington. A memorial service was held on Saturday afternoon at St. James's Church, Piccadilly, and was attended

[1] Even Foster's writings were not always free from oversights. In one passage he advises the reader to "get a firm hold of the most prominent feature of the subject", in another he corrects a woodcut by explaining that the granules "have been rendered too bold by the artist."

by many leading men of science The Royal Society, of which Sir Michael Foster was a secretary for twenty-two years, was represented by Lord Rayleigh, O M, president, Prof D Ferrier, vice-president, Sir Archibald Geikie, secretary, Mr R Harrison, assistant secretary, and a large number of fellows of the society Among those present were Lord Reay (president of the British Academy), Lord Monkswell, Sir William Crookes Sir Philip Magnus, M P, Sir Arthur Rucker (principal of the University of London) and Lady Rucker, Sir Norman and Lady Lockyer (British Science Guild), Major MacMahon (British Association), Sir William Ramsay, Sir Joseph Swan, Sir J Crichton-Browne, Sir James Blyth Prof R Meldola (president of the Chemical Society), Dr Russell Wells, Prof S P Thompson, Dr E Divers, Dr J Kingston Fowler (dean of the faculty of medicine at the University of London), Prof Wyndham Dunstan, Prof Tilden, Prof Priebsch, Sir Alexander Pedler, Dr Bashford, Prof Thane, Prof Starling, Dr Hugo Muller, Prof Emerson Reynolds, Sir Henry Howorth, Prof McLeod, Sir H Trueman Wood, Dr Horace Brown, Prof Judd Prof Hull, and Mr Frederick Macmillan

A large and representative congregation also attended the memorial service held in Trinity College Chapel, Cambridge, of which college Sir Michael was a fellow The congregation included the Vice-Chancellor (the Rev F S Roberts, Master of Caius), Profs Sir R S Ball E C Clark, T Clifford Allbutt A Macalister, A R Forsyth Carey Foster F Howard Marsh, G Sims Woodhead H Jackson, and A C Seward, Dr W N Shaw and the following representatives of learned societies —University of Oxford, Prof Poulton Dr Collier Prof Gotch, the Royal Society, Mr A B Kempe (treasurer) Mr F Darwin (foreign secretary) and other councillors University College, London, Prof H S Foxwell, British Association, Sir George Darwin and Mr A E Shipley, Cambridge Philosophical Society, Dr Hobson (president) and Mr H F Newall (treasurer) the Epidemiological Society of London, Dr H Timbrell Bulstrode Manchester University, Prof Lamb and Prof Conway

NOTES

AT the forthcoming meeting of the British Association in Leicester, the evening lectures will be by Mr W Duddell, on "The Arc and the Spark in Radio-telegraphy" and by Dr F A Dixey on "Recent Developments in the Theory of Mimicry" The lecture to the operative classes will be given by Prof H A Miers, F R S, on "The Growth of a Crystal"

WE notice with deep regret that Prof D I Mendeléeff, the eminent Russian chemist who was born seventy three years ago to-day, died on February 2 Prof Mendeléeff was the subject of a "Scientific Worthy" article in NATURE of June 27, 1889 (vol xl p 193) and we hope to supplement this next week with a short account of work accomplished by him since that date

WE learn from the *British Medical Journal* that the seventh International Congress of Physiology will be held this year at Heidelberg on August 13–16, under the presidency of Prof August Kossel In connection with the congress there will be an exhibition of scientific apparatus Announcements of communications should be sent to the Physiological Institute, Heidelberg, before June 15

A REUTER message from Melbourne on January 31 reports that slight shocks of earthquake have occurred at Eden, New South Wales, and at Gabo Island, off the coast of Victoria Severe shocks were felt in north-eastern Tasmania on January 30 News has reached Melbourne that two severe and prolonged shocks were felt in the Tonga Islands on January 2

Science announces that Dr Otto Lummer, professor of experimental physics at Breslau, will begin a course of ten lectures at Columbia University on February 15 Prof J Larmor, Sec R S, will begin a course of six lectures on March 27 Mr W Bateson, F R S, will give the Silliman memorial lectures at Yale University next year The preceding lecturers on this foundation have been Prof J J Thomson, F R S Prof C S Sherrington, F R S, Prof Ernest Rutherford, F R S, and Prof W Nernst

ON Tuesday next February 12 Prof W Stirling will begin a course of six lectures at the Royal Institution on "The Visual Apparatus of Man and Animals" on Thursday, February 14, Mr A Harker will give the first of two lectures on "The Minute Structures of Igneous Rocks and their Significance", and on Saturday, February 16, Prof J J Thomson will commence a course of six lectures on "Rontgen, Kathode and Positive Rays" The Friday evening discourse on February 15 will be by Mr J J Lister on "Foraminifera"

A COMMITTEE has been appointed by the Board of Treasury to inquire generally into the work now performed at the National Physical Laboratory with special reference to the character of the tests undertaken there and the lines on which any further development of the work of the laboratory should proceed The committee consists of Mr G W Balfour chairman Sir Andrew Noble Bart K C B, F R S Sir J Wolfe Barry K C B F R S Mr W J Crossley M P, and Mr R Chalmers C B Mr G C Upcott of the Treasury will act as secretary to the committee

UPON the authority of the *Figaro* the Paris correspondant of the *Times* reports that M Daniel Osiris has left by his will a sum of one million sterling to the Pasteur Institute The bequest by which the Pasteur Institute thus benefits will provide it with an annual income of from 30 000*l* to 40 000*l* It is already one of the best endowed scientific institutions in the world, and this princely gift will enable it to organise on a practical basis a large number of new branch establishments for scientific research all over France and in the French colonies

COLONEL JOHN MERCER BROOKE whose death in his eightieth year was recently announced was best known as the inventor of a deep sea sounding apparatus which was subsequently superseded by that of Lord Kelvin During the American Civil War, Colonel Brooke, along with Maury, the distinguished hydrographer, associated himself with the seceding States, and was successful in effecting many improvements in the cannon of the time At the close of the war he was appointed a professor in the Virginia Military Institute at Lexington, and held the chair of physics and astronomy until 1899 In the years preceding the Civil War, he was engaged in making hydrographic surveys in the Pacific Ocean, particularly in the archipelago and along the coasts of China and Japan

A RECENT Reuter message from Entebbe shows that the new Commissioner of Uganda is making vigorous efforts to combat the scourge of sleeping sickness Acting upon the discoveries made by the Royal Society's commission with regard to the transmission of the disease by the local species of tsetse-fly, it is sought to render the fly innocuous by preventing it from becoming infected with the micro-organism (Trypanosoma) which causes the disease With this end in view the natives are being removed from the

lake shore, the region which is the special haunt of the tsetse fly in question while at the lake ports, such as Entebbe and Jinja, every effort is being made to oust the fly by destroying the vegetation which harbours it and Entebbe is already reported to be clear of fly It is only to be hoped that the process of deforestation will be carried out with discretion as well as with zeal, and only those tracts denuded of forest which have been definitely proved to harbour the tsetse, a forest tree may be destroyed in half an hour which a hundred years will not replace The experience of other diseases transmitted by biting insects such as yellow fever, indicates that the most efficient method of preventing the spread of the disease is to isolate the patients in such a way as to prevent them from infecting the insects which are the carriers If it is possible to carry this out on so large a scale as the Protectorate Government is trying to do it, we may hope to see in a few years the disease stamped out completely in the territory of Uganda The Commissioner is to be congratulated on the promptness and energy with which he is turning the conclusions of scientific investigation to practical use

AN interesting innovation in coal-mining practice is reported from the United States where at a colliery at Shamokin Pennsylvania concrete has been substituted for mine timbering A plant for the manufacture of these cement props is in course of erection at Trevorton

ON January 28 coal was struck at Lord Dudley's sinkings at Baggeridge Woods at a depth of 556 yards The seam is 20 feet thick, and beds of excellent ironstone have also been encountered The discovery has verified the prediction of geologists regarding the existence of Coal measures under the sandstone to the west of the South Staffordshire coalfield This is the first place where coal has been found on the eastern side of the great Western Boundary fault, and the discovery is one of national importance The work of sinking was commenced nine years ago and great difficulties had to be contended with in consequence of the large quantities of water encountered

THE Transvaal Geological Survey has issued a monograph (Memoir No 3, Pretoria, 1906 price 7s 6d) by Mr E T Mellor, on the geology of the Transvaal Coal measures, with special reference to the Witbank coal field It contains a detailed account of the coal resources of the Witbank district at the present time the most important coalfield in the Transvaal In addition the available information regarding the geology of the Coal measures of the Transvaal in general is ably summarised Notes on the correlation of the Transvaal Coal-measures a list of the fossils of the Transvaal Coal-measures analyses of the coals statistics of production from 1893 to 1906 and a useful bibliography are appended The memoir covers sixty pages and is accompanied by a map, six sections, and fourteen plates reproduced from photographs

IN the *Engineer* of February 1 there is a copiously illustrated description of the Tehuantepec railway and of the terminal harbours at Salina Cruz, on the Pacific, and *Coatzacoalcos*, on the Gulf of Mexico, which were formally opened by the President of the Republic of Mexico on January 23 The length of the line is 189 miles, and the opening up of a trade route across the isthmus will be of special benefit to the middle west of the United States The average saving in distance by the Tehuantepec route over a Panama canal for traffic between Europe or the Atlantic ports of the United States is about 1250 miles Proposals to construct a railway across the isthmus were made as long ago as 1842, and a railway was completed by 1894, the Mexican Government having spent on the undertaking 3 500,000*l* The railway, however, was not adapted for heavy traffic, and had no terminal facilities or harbour works In 1898 the Government entered into a contract with the London firm of S. Pearson and Son, Ltd , to reconstruct the line and to provide harbour accommodation This has now been done at a cost of 9,500,000*l* and the railway will undoubtedly prove a formidable competitor to the Panama Canal when that difficult enterprise is completed For the Panama Canal the Americans have decided on a lock-canal system , but this system cannot Mr P Bunau Varilla points out in a very important paper contributed to the Society of Arts (Journal vol lv , p 239), be looked forward to with complacency in a volcanic neighbourhood subject to earthquakes Mr Bunau-Varilla who had been connected with the Panama Canal since 1884, proposes a well-considered alternative scheme in which water is used as the carrying power for the machinery to do the excavating and for the transport of the dredged material In short, the heavy rainfall is not treated as an enemy, but converted into a friend and ally In this way Mr Bunau-Varilla claims to have solved the problem set by Charles V in 1523 to Cortes Discover the secret of the straits (*el Secreto del Estrecho*) The secret lies in the topography and hydraulics of the isthmus Everything has been prepared by nature, in the high valley of the Chagres, to lift the earth that obstructs the site of the straits Harness this power and the straits will be made by its spontaneous action

IN a document issued by the Public Works Department, the director of the Zoological Gardens at Giza announces that he has returned from a trip to the Sudan, bringing with him a number of animals, inclusive of a giraffe, three young elephants, and five ril gazelles (*Gazella ruficollis*)

HAVING in earlier issues of the same journal discussed the filtering apparatus attached to the gill-rakers of various groups of surface fishes especially those which feed on plankton Dr Enoch Zander in part ii of vol lxxxv of the *Zeitschrift für wissenschaftliche Zoologie* records the results of his investigations in connection with corresponding structures in deep-sea fishes The general results arrived at in the case of surface-dwelling species hold good in the main for deep-sea fishes, forms living in open water usually having the filtering apparatus much more strongly developed than in the bottom-dwelling types The large-headed open water genus Stomias is, however, an exception in this respect

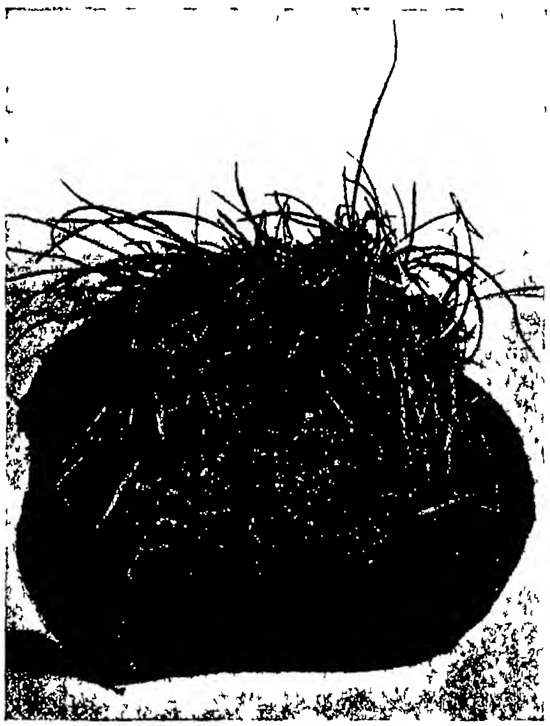
IN the *American Naturalist* for January Mr E Linton describes the manner in which the parasitic fish *Fierasfer affinis* effects an entrance into the body of the sea-cucumber which serves as its host Although the observations are not entirely new, they are of considerable interest When the small pellucid fish comes alongside of the holothurian it gradually feels its way down the body of the latter by means of its head until it reaches the vent, when it immediately curls itself into a loop and thrusts the tip of its whip-like tail into the aperture of the latter When this is accomplished, the fish straightens its body and proceeds leisurely to insinuate itself tail-first, into the body of its host, the action being apparently assisted by the spines of the dorsal and ventral fins The whole process occupies only about half a minute

MUCH interest attaches to an account, by Mr James Murray, in the January number of the *Zoologist*, of a remarkable "encystment" undergone by a British species of so-called "water-bear" (Macrobiotus). Certain peculiar little yellow elliptical or sausage-shaped packages, from which, when squeezed, water-bears in a quiescent condition spurted out, were, it appears, first observed. Subsequent investigation proved these to be an early stage of the encystment of these creatures. In the species fully examined there is an outer cyst with six rudimentary legs; inside this is an inner, limbless cyst containing at first a fully developed water-bear. Later on the Macrobiotus shrinks to an almost amorphous condition, so that it looks more like a worm. What happens afterwards and likewise the object of these strange changes have yet to be ascertained. A similar encystment was detected almost synchronously by Prof. Lauterborn in the case of a Continental species. In the same issue Mr. A. Campbell describes certain naked house-mice similar to a type described in 1856 as *Mus musculus nudoplicatus*. Since, however, this phase is a pathological development, it has obviously no right to a racial name.

THE U.S. Bureau of Entomology has re-issued (Bulletin No. 26) a report, published in 1895, on the San José or Chinese scale-insect (*Aspidiotus perniciosus*) in a revised and expanded form, so as to include an account of the investigations and remedial measures which have been undertaken and suggested since that date. The author of the new publication is Mr. C. L. Marlatt, acting chief of the Bureau. The insect, it seems, first made its appearance in America in the early seventies at San José, California, on the estate of the late Mr. James Lick, who was in the habit of importing plants from abroad. It was not, however, until 1901, as the result of a special expedition, that its native home was definitely located in north-eastern China. The isolated condition of this habitat is considered to be the reason that prevented the pest from overrunning a large portion of the world centuries ago. Despite the destruction caused to orchards when it once obtains a footing, the pest is now to a great extent under control, mainly owing to a lime-sulphur wash. In some degree the invasion has, indeed, been a blessing in disguise, since the greater care rendered necessary in selection, planting, and culture has largely benefited fruit-growing in general. At one time great hopes were entertained that a Chinese ladybird would form the most efficient restraining agent, but the use of washes and the presence of a parasite were inimical to the beetle.

WE have to acknowledge the receipt of the first three parts of a new publication from the Museum für Natur- und Heimatkunde zu Magdeburg, edited by Prof. A. Mertens, the director of the museum. By far the most important item in these *Abhandlungen und Berichte* is a paper by the editor on the urus or aurochs (*Bos primigenius*), which occupies the whole of part ii. The author gives a review and digest of the whole of the early literature and documents relating to the ancient wild ox of Europe, as well as of the comments upon them by previous writers. In his opinion, there is no doubt that the name aurochs properly belongs to this animal, although it has often been misapplied to the bison. It is likewise certain that in the time of Herberstain (the middle of the sixteenth century) both aurochs and bison were living in Poland, and that they were seen alive by him. According to other testimony, there was living in the Jaktorowka (or Wiskitki) forest, of the Masovia district of Poland, in the year 1564 a herd of thirty aurochs. By 1599 the number was reduced to twenty-four, while in 1602 only four remained, these being reduced in 1620 to a single cow, which appears to have been alive seven years later. It seems, however, that a few half-domesticated individuals were living in captivity in 1627. Herberstain's testimony that the aurochs was typically a black (or at all events a very dark-coloured) animal with a light dorsal streak is accepted. Other evidence tends, however, to show that there was a grey variety or phase in Poland, and a red one in central Germany, while the partially domesticated individuals kept in confinement during the early part of the seventeenth century may have developed other colour phases with partial albinism. Several particulars with regard to the breeding and general habits of the aurochs are also given.

IN a fifth instalment of his "Studies of Mexican and Central American Plants," published as vol. x., part iii., of the Contributions from the United States National Herbarium, Dr. J. N. Rose describes a large number of new species. The author being greatly interested in cacti, made them the subject of special investigation during his trip in 1905, and has identified several new and interesting specimens that are described and illustrated. In some cases numerous individuals cluster together to form a large cushion, as *Echinocactus robustus*; others develop into strange arboreal structures producing hundreds of nearly erect branches, notably *Cereus Webberi*, while *Echinocactus ingens* produces a large circular body that is cut up into sections resembling Dutch cheeses and boiled with sugar to make candy. Even more curious is the liliaceous plant shown in the illustration here reproduced, that is characterised by its thick corky exterior, and lives upon the food absorbed through a few fibrous roots; it forms the type of a new genus named after Shakespeare's Caliban, *Calibanus caespitosus*.



Calibanus caespitosus (Scheidw.) Rose.

IN the Journal of the Royal Microscopical Society for December, 1906, Dr. Alfred C. Stokes contributes a note on a certain form of butterfly scale the structure of which well illustrates certain points in connection with the much-studied "Podura" scale. He says:—"These special wing-scales are formed of three distinct membranes, of which the upper and the lower bear longitudinal ribs, between which both membranes are distinctly, even conspicuously, perforated by minute apertures arranged in rows more or less horizontal." It appears not to be generally known that the "clouded yellow" (*Colias edusa*) possesses pear-shaped wing-scales mixed with the ordinary scales, corresponding more or less closely to Dr. Stokes's description. These special scales seem to take the place of the "plumules" of many Pieridæ and Satyridæ, and of the "battledore" scales of Lycænidæ.

THE growth of the sudd on the Upper Nile and the blocking of American rivers with plants of the water fern, Azolla, are well-known examples of the danger arising out of the undue development of certain water weeds. The most recent instance is recorded from Australia, where the water hyacinth, *Pontederia* (*Eichhornia*) *crassipes*, characterised by its bladder-like swollen petioles and attractive blue flowers, has, owing to its rapid propagation by means of offsets, become a nuisance in the northern rivers of New South Wales and in Queensland. A report prepared by the order of the Minister for Public Works in New South Wales discusses the origin of the plant, the methods and cost of eradication, and proposes that a Noxious Weeds Bill should be introduced into Parliament.

THE report of the International Committee on Atomic Weights for 1907 is published in the current number (No. 310) of the Proceedings of the Chemical Society. New values are suggested, on the basis of determinations made during the past year, for bismuth, nitrogen, tantalum and terbium, and the opinion is expressed that alterations are needed in the atomic weights of silver and chlorine. Before, however, recommending any change as regards these elements, the committee deems it advisable to wait for fuller information of the results of determinations known to be in progress, as the new values for silver and chlorine will have an influence on a large number of atomic weights.

IN a paper on the relation of chemical activity to electrolytic conductivity by Mr. John L. Sammis, published in the *Journal of Physical Chemistry* (vol. x., No. 8), a large number of experimental observations are cited as disproving the views of Arrhenius and Ostwald that chemical activity in solution is proportional to the electrolytic conduction. The activity of acids in inverting sugar, catalysing esters, and dissolving magnesium is changed by the addition of benzene to the aqueous solution employed at a rate disproportionate to the conductivity. The replacement of one metal by another is said to take place in molten salts or solutions which are the best of insulators as well as in liquids which are good electrolytes. It was found that in sixty-nine non-conducting solutions of copper oleate prepared with different solvents copper was easily precipitated by lead, whilst in fourteen other non-conducting solutions lead did not replace copper. The general purpose of the paper is to emphasise the view that the solvent is not indifferent to the solute. It is contended that the facts brought forward are explainable only on the hypothesis that "chemical" union occurs between the solvent and the dissolved substance.

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 8.	16h.	Venus at greatest elongation, 46° 53′ W.
,,	19h.	Venus in conjunction with the Moon. Venus 0° 51′ N.
9.	10h.	Minimum of Algol (β Persei).
12.	6h. 49m.	Minimum of Algol (β Persei).
15.	20h.	Vesta in conjunction with the Moon. Vesta 0° 42′ S.
19.	6h. 31m. to 9h. 33m.	Transit of Jupiter's Sat. III. (Ganymede).
20.	23h.	Conjunction of Mercury and Saturn. Mercury 1° 40′ N.
22.	6h.	Conjunction of Jupiter with the Moon. Jupiter 2° 45′ N.
,,	16h. 8m. to 16h. 58m.	Moon occults ν Geminorum (mag. 4·1).
23.	7h. 11m. to 8h. 29m.	Moon occults ζ Geminorum (variable).
25.	5h. 30m. to 6h. 31m.	Moon occults δ Cancri (mag. 4·2).
26.	10h. 12m. to 13h. 14m.	Transit of Jupiter's Sat. III. (Ganymede).

MICROMETER MEASURES DURING THE SOLAR ECLIPSE OF AUGUST, 1905.—At the meeting of the Paris Academy of Sciences held on January 7, M. J. Merlin submitted a paper discussing the micrometer measures made at Roquetas (Spain) by MM. André and Guillaume during the total solar eclipse of August, 1905. From this discussion he arrives at the conclusion that the lunar-parallax constant determined by Prof. Newcomb is not affected by any error sufficiently large to be detected by the measurements carried out. There is, however, room to correct the relative positions of the sun and moon as given in the *Connaissance des Temps*, although the correction does not modify the apparent trajectory of the moon in regard to the sun, it serves only to advance the position of the former in that trajectory by an amount corresponding to an advance of 11·1 seconds in the calculated times of the contacts (*Comptes rendus*, January 7).

HEIGHTS OF METEORS OBSERVED IN 1906.—In No. 4152 of the *Astronomische Nachrichten* Mr. Denning gives the heights, lengths of paths, and velocities of ten large meteors observed in England during 1906. The heights at the commencement of visibility varied from fifty-nine to eighty-nine miles, whilst those at disappearance varied from twenty-two to fifty-six miles. Seventy-two miles was the length of the longest path recorded, and twenty-four miles that of the shortest. The velocities determined lie between fifteen and thirty miles per second, the latter value having been determined for a Perseid observed on August 5, 1906.

A QUICKLY CHANGING VARIABLE STAR.—In Bulletin No. 9 of the Laws Observatory, University of Missouri, Mr. F. H. Seares discusses the observations of the quickly changing variable star RR Draconis (188.1904) which were made at that observatory during 1905–6. The variable is of the Algol type, with a period of about 2·8 days, and its light-curve is peculiar in being extraordinarily steep about the time of minimum. The latter could not be determined exactly, because the star becomes invisible for about two hours in the 7½-inch refractor employed, but the observations plainly showed that the range is greater than three magnitudes, and that the rate of change at the time of disappearance is one magnitude in half an hour. The normal magnitude of this object is 9·98, and the elements of its period, as determined from these observations, are:—

Min. = J.D. 2417026·682 + 2·831079d. F. G. M. T.

Some of the residuals suggest the possibility of a variation in the period, but for the present this possibility remains very uncertain.

METCALF'S COMET 1906*h*.—Another set of elliptic elements for comet 1906*h* has been calculated by Mr. Crawford from observations made at the Lick Observatory. This gives October 5·66, 1906, as the time of perihelion passage, and 8·23752 years as the period of the comet (Lick Observatory Bulletin, No. 108).

THE ERUPTION OF MATAVANU IN SAVAII, 1905–6

THE last-issued number of the *Zeitschrift der gesellschaft für Erdkunde zu Berlin* contains an account of a very remarkable volcanic eruption which had been in progress for more than twelve months in September last in the island of Savaii. The volcanoes of this island had been quiet for more than a century when, in 1902, two minor outbreaks occurred, and in 1905 a greater eruption commenced, causing so much anxiety and alarm that the German Colonial Administration sent to Prof. K. Sapper, of Tübingen, a collection of specimens, photographs, and newspaper and other reports, from which he has compiled an account which is interesting in spite of its inevitable incompleteness.

The eruption was ushered in by a series of earthquakes lasting from July 25 to August 1, 1905, at half past nine on the night of the last-mentioned date a loud detonation was heard, and shortly after "pillars of fire" were seen issuing from a valley known as Matavanu some 12 kilometres from the coast on the north-eastern side of the island. At first the eruption was of an explosive character, and does not seem to have been very violent, as the estimates of the height to which matter was thrown do not exceed 200 metres and the hill formed was never more than 150 metres in height. On August 9 lava began to flow, at first in small quantities, afterwards more abundantly, until it reached the coast on December 6, and flowed down to the sea at intervals up to the end of September, 1906, the date of the latest reports received by Prof. Sapper. During this period the outflow of lava seems to have been continuous, though varying in amount, and unaccompanied by any considerable degree of explosive activity.

Many people visited the volcano during the eruption, and an interesting account by Dr. Grevel is reprinted from the local newspaper. His party made the ascent on April 23 last, over the crust of the lava stream, which was smooth and easily traversed, and cool enough for the Samoans who accompanied him to walk over it. The solid surface of the lava stream was broken at intervals by vent holes, the one nearest the crater being at first mistaken for a parasitic cone, as the crust of the lava rose in a gentle convexity to the orifice, which was much smaller in diameter than the cavity underneath. Thick sulphurous vapours prevented any sight into the cavity, and large stones thrown in gave no clue to its depth, as their fall was unheard. Four of these vent holes were examined, which repeated the features of the first on a smaller scale, and the party then climbed to the crater by an easy ascent over the lava flow on the northern side. Owing to the drift of the south-east trade wind, no view of the crater could be obtained, so Dr. Grevel and his party worked round by the east, where the surface was covered with countless bodies of moths, attracted by the glow of the crater and killed by the vapours rising from cracks in the surface of the lava flow, the same vapours had proved fatal to a flying-fox, a dove, and a sea-gull. From the southern edge a good view of the crater was obtained, it was about 300 metres in diameter, filled with a lake of molten lava in gentle ebullition caused by the rise of steam bubbles, and from the centre a gentle streaming to the north commenced, which increased in rapidity until the lava disappeared in a cataract into a cloud of steam, and presumably joined the stream over the surface of which the party had ascended.

On reaching the sea, the lava flowed out to the reef, where its end, being cooled by the surf, formed a wall between which and the coast the lava flowed quietly along the lagoon. At its end the sea was in violent ebullition, dense clouds of steam were formed, and for 100 metres from the end of the flow the sea was boiling hot, and fishes, killed and cooked by this boiling sea-water, were collected and eaten by the natives. In a few places the lava flowed over the reef into the deep water outside, and where this occurred its progress was marked by violent geyser-like explosions, which were mistaken by some people for fresh volcanic eruptions, but were in reality due to steam formed under the still liquid lava. We reproduce a very striking photograph of one of these geyser-like explosions at the front of a lava stream flowing into the deep sea. The lava was remarkable for its fluidity, and issued in great quantity, according to a map attached to Prof. Sapper's paper the area covered by the lava extends about 6 kilometres to the west and 12 kilometres to the north-east of the volcano, and has a width of from 2 kilometres to 5 kilometres. It has filled the lagoon for about 8 kilometres along the coast, destroying several villages and rendering others uninhabitable by cutting off their water supply, while several small promontories of lava were thrust forward beyond the reef.

Lava flowing under its consolidated upper crust into the sea near Salago, September, 1906.

RESEARCH IN TROPICAL MEDICINE AND HYGIENE[1]

(1) THE greater part of the first report is occupied with an elaborate memoir by Drs. Thomas and Breinl on trypanosomes, trypanosomiasis, and sleeping sickness. It comprises a description of cases of sleeping sickness, a full account of inoculation experiments with the *Trypanosoma gambiense*, from which the conclusion is formulated that the trypanosomes of sleeping sickness of Uganda and of the Congo Free State and of trypanosomiasis are identical, together with an account of the pathological anatomy and histology of trypanosomiasis, the action of various drugs on trypanosomes, and experiments with the trypanosomes of surra, mal de caderas, dourine, &c.

The late Mr. Dutton and Dr. Todd contribute an important memoir on human tick fever in the Congo Free State, with an appendix by Mr. Newstead on the anatomy of the tick (*Ornithodoros moubata*) which conveys the disease.

[1] (1) "The Thompson Yates and Johnston Laboratories Report." Edited by Rubert Boyce and Charles Sherrington, with H. F. Annett, Benjamin Moore, Ronald Ross, and E. W. Hope. Pp. 141. Vol. vi. (New Series.) Part ii. December, 1905.
(2) *Ibid.* Vol. vii., Part i., February, 1906. Pp. 85+plates.
(3) "Rapport sur l'Expédition au Congo, 1903–5." Par J. Everett Dutton and John L. Todd. (École de Médecine Tropicale de Liverpool, Mém. xx.) Pp. 7? (All published for the University Press of Liverpool by Williams and Norgate, London, 1906.) Price 5s.
(4) "Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum." By Andrew Balfour.

Lastly, Surgeon Ross, R.N., contributes a short paper on the habits of the marine mosquito (*Acartomyia zammitii*).

(2) The second report contains papers on a new species of louse (*Haematopinus stephensi*) which acts as the intermediary host of a new hæmogregarine parasite in the blood of the Indian field rat, by Mr. Christophers and Mr. Newstead; a note on the anatomy of *Gastrodiscus hominis*, a human fluke, by Dr. Stephens; a revision of the Sarcopsyllidæ, by Dr. Karl Jordan and the Hon. N. C. Rothschild, a family of fleas which includes the jigger, and the rat flea supposed to transmit plague to man; and a description of the maiotic process in Mammalia, by Messrs. Moore and Walker. The last-named paper is illustrated with a number of beautiful plates, and is well worthy of study.

(3) In this report the late Mr. Dutton and Dr. Todd, after some general remarks on the conditions favouring the spread of malaria, describe the conditions existing at some of the towns and posts of the Congo Free State, and formulate recommendations for remedying these. Dr. Breinl and Mr. Kinghorn describe experiments showing that the Spirochæte of African tick fever is infective for the horse, dog, rabbit, guinea-pig, rat, and mouse, in addition to monkeys, whereas the *Spirochaeta obermeieri* of relapsing fever is infective for monkeys only. Dr. Breinl has also compared the immunity produced by these two Spirochætes, and finds that each strain produces considerable active immunity against re-infection, but does not produce immunity against infection with the other strain. The course of the disease also varies with the two strains, and the conclusion therefore is that tick fever and relapsing fever are produced by different species of Spirochætes.

(4) The second report of the Wellcome Research Laboratories of the Gordon College, Khartoum, by Dr. Andrew Balfour, the director, maintains the high standard of the first one (see NATURE, vol. lxxi., p. 605) both as regards the nature of the work recorded and the manner in which it is presented to the reader. Nearly half the volume comprises records of mosquito work in Khartoum, of biting and noxious insects, mosquitoes and other human, animal, and vegetable pests of the Sudan. Dr. Balfour describes a hæmogregarine parasite of the jerboa and a leucocytozoon of mammals, and contributes a report on cattle and equine trypanosomiasis in the Anglo-Egyptian Sudan. Fortunately human trypanosomiasis and sleeping sickness do not yet seem to be endemic in this part of Africa, nor has the tsetse fly which conveys it (*G. palpalis*) been described here. In the chemical laboratory a considerable amount of work has been done by Dr. W. Beam, the chemist, on water analysis, Sudan grains and gums, &c. The travelling naturalist, Mr. Sheffield Neave, records many interesting observations on blood, blood parasites, &c., of birds, fish, and other animals.

R. T. HEWLETT.

PRESIDENTIAL ADDRESSES AT THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION.

A GENERAL article upon the proceedings of the American Association for the Advancement of Science at the meeting held at New York during the Christmas vacation appeared in NATURE of January 24 (p. 304). Through the kindness of the general secretary of the association, Dr. L. O. Howard, we have received copies of several of the addresses delivered by the president and by the chairmen of sections, but limitations of space will not permit us to publish any of them in full. The subjoined extracts from these addresses will, however, afford an indication of the subjects considered and the views expressed.

EDUCATIONAL THEORIES, ANCIENT AND MODERN.[1]

The Greek idea of education and culture was based upon the existence of a privileged class, fed, clothed, and sheltered by the labour of slaves—a real aristocracy devoted to war, art, literature, and luxurious living. The sway of the so-called classic idea of education has been, and still is, one of the marvels of history. The splendour of Greek art, the brilliancy of Greek literature, and the keenness of Greek logic, have held the world as in a trance, unable to break away from its charms—though it has been unsuited to other peoples and other social conditions.

Francis Bacon more than any other man showed the inadequacy of the classic method, fine as it was along certain lines, and the comparative worthlessness of scholasticism, and he opened the eyes of the educated people of his time to the wealth of opportunity for interesting and profitable study in the great laboratory of nature, and, better than all else, he set forth the dignity and intellectual value of science study, and vigorously scouted the idea that the usefulness of scientific truth in any degree detracted from its educational value.

But none of the writers touching on education, with the possible exception of Froebel and Pestalozzi, not even Locke, Milton, or Dr. Samuel Johnson, looked at the matter from the scientific standpoint, which takes into account, first, the physiological laws which govern the growth and development of the brain; secondly, the exterior stimuli for promoting that growth most successfully; and, thirdly, the kind and quantity of knowledge and skill one must have in order to meet most completely the demands of a carefully selected occupation.

Every good teacher aims to make his subject as interesting as possible to his pupils. If they fail to take a lively interest in it something is wrong: either it is not properly presented, or it is over their heads, or it is clearly of no earthly use. Natural lack of capacity on the part of the child is rarely a valid reason for failure if the child be healthy and normal. I have learned to discredit the truth of the oft-told tale that "John has no capacity for" such a subject—mathematics, for example. "He never could learn mathematics—he takes no interest in algebra, and he hates geometry," &c. Our higher schools and colleges are full of young people who protest vigorously that they never could, and never can, understand or take any pleasure in or gain any profit from certain studies. I firmly believe that every normal person, at least nine out of ten of the children and youth at school and college, can fairly master and actually enjoy and profit by not only mathematics but by every subject in the curriculum if it be properly taught and under proper conditions as to age and preparation.

Attention is as necessary to the growth and development of the brain as exercise is to the development of a muscle, and interest is the condition of a lively attention. When in a school or lecture-room the limit of close attention is reached, the lesson or lecture should close, for the educational process has already stopped. It is not only useless but it is worse than useless to go on when the class or audience refuses for any reason to attend. I therefore doubt the educational value of subjects which are not, and perhaps cannot be, made interesting.

Of course I do not claim that all selected studies can be made equally interesting, or that any one study can be made equally interesting to all pupils, even when the pupils are properly graded; but I do claim that a lively interest is necessary, and that educational progress is very nearly proportional to the strength of that interest.

Perhaps the most valuable contribution to the science of education has come through a study of the laws which obtain in the growth and development of the brain, and the conditions under which that growth and development is most healthy and complete. There are times and seasons for the development of the mental and moral faculties as there are of the physical faculties. While such times and seasons are not precisely the same for all children, we find that all attempts at premature development are not only worthless, but are permanently injurious. Precocity is now regarded as a species of brain deformity. Plants and animals may be forced, and unusual and interesting results may be produced by forcing, but no one of us wishes a son or a daughter to be a prodigy in one direction at the cost of normal development in other directions.

The psychologists tell us that the brain-cells develop as do other physical organs, not only through thought,

[1] From an address delivered by Prof. C. M. Woodward, president of the American Association.

but through muscular activity and the exercise of our senses Accordingly, a healthy and timely growth and development of the brain is to be promoted by an education involving a great variety of activities, skilfully adjusted as to quality and quantity to the mental and physical status of the child

Closely related with this of brain culture is the subject of manual training, which has recently gained a foothold in our scheme of rational education Its nature and educational value are still under discussion

The manual-training movement stands inevitably as a criticism upon the system of education which came down the ages through the fathers to us, and naturally the latter stands on the defensive It also is a standing reproof to the old wasteful, unscientific method of teaching apprentices the theory and uses of tools It is for educational science to justify the ways of progress, which lays aside the idols of the past and erects new temples and opens new kingdoms Of all the temples, none is finer, none is more glorious, and none should be more scientifically planned and reared than education

The evolution of the fully fledged technical school, or the technical department of the university, has taken place during the last half-century, and yet its broad, stimulating attractive features have a following which bids fair to double the attendance of college and university students This does not mean that letters and polite learning are being neglected but that a new constituency is eager for the new education This new education though it recognises it all points a high order of usefulness and contains little that is conventional, is only remotely professional If ever its curriculum becomes narrow it is quickly condemned by the best representatives of an education which combines utility with culture No longer can the "Levites of culture" as Huxley calls them claim to monopolise liberal education The new education can be as liberal as the old, and both can be narrow Fortunately, they flourish side by side and the future shall choose the excellences of each An adequate science of twentieth-century education will evaluate the characteristics of each and bring the wisdom of the past, not its foolishness, to nourish the wisdom of the future

ACCURACY OF ASTRONOMICAL CLOCKS [1]

The accuracy with which our astronomical clocks perform their function is a subject of interest The earliest star catalogue of precision is that of Bradley In discussing the performance of his clock I have used the adopted rates as given by Auwers in his re-reduction of Bradley The monthly means of the rates from July, 1758 to July 1759, were taken, and the difference of each rate from its monthly mean Then the mean of these differences, without regard to sign, was taken for each month

The rates of two other clocks of the Greenwich Observatory were likewise discussed, the standard clock for the year 1850 and that for 1900, the adopted daily rates as published in the annual volumes being used The first of these was kept in the observing room, and thereby subjected to large variations of temperature while the second made in 1871 by E Dent and Co , was fixed to the north wall of the magnetic basement, as in this apartment the temperature is kept nearly uniform. The pendulum of this latter clock is provided with barometric as well as thermometric compensation

There are two well-known clocks which should be mentioned, and in conclusion I will give some hitherto unpublished data concerning the clock with which I have been working during the past three years

Probably no clock has had its rate more thoroughly discussed than Hohwü No 17, the standard clock of the observatory at Leyden It was set up in the transit room in 1861, and in December, 1898, was removed to the large hall of the observatory, where, enclosed in two wooden cases, it was placed in a niche cut in the pier of the 10-inch refractor Further, to guard against sudden changes of temperature, the niche is closed by a glass door At the meeting of the Royal Academy of Sciences at Amsterdam held September 27 1902, Dr E F van de Sande Bakhuyzen submitted a formula as the best representation of the daily rate of the clock and gave the result of a comparison of the observed daily rates 1899–1902, the average interval of time for each rate being six days, with those computed by means of the formula I find that during the year 1900 the mean of these differences is 0·028s , and the largest difference is 0·071s

About 1867, Tiede installed at the Berlin Observatory a weight-driven clock enclosed in an air-tight case The original escapement was replaced in 1876 by a gravity escapement, and the clock continued to give satisfaction certainly up to 1902, when it was dismounted for cleaning The only published rates that I have been able to secure are those during twelve weeks in 1877–8 During this period the average deviation of the observed daily rates the average interval for each rate being six days, from the mean daily rate for the entire period is 0·030s

In 1903 there was installed at the U S Naval Observatory one of Riefler's clocks, No 70, with a nickel-steel pendulum, the impulse being communicated to the pendulum through the suspension spring This clock was enclosed in an air tight glass case and was mounted in a vault where the temperature was artificially controlled The definitive rates have been determined from September 1903, to May 1904, but unfortunately during this entire period we were unable to prevent the glass case leaking and there was a variation of temperature in the vault of about 5° C

Collecting together the results obtained we have —

Mean Deviation of Daily Clock Rate

Clock	Date	Mean Deviation
Bradley	1759	0·102
Greenwich Observatory	1850	0·149
Greenwich Observatory	1900	0·051
Berlin Observatory	1877	0·02 0·03
Leyden Observatory	1900	0·028
U S Naval Observatory	1904	0·015

FACT AND THEORY IN SPECTROSCOPY [1]

Any treatment of the production of radiation falls more or less naturally into three parts, namely (1) the radiation of solid and liquid bodies which is almost, but not quite, independent of atomic structure, (2) the radiation which takes its rise in radio-active substances and which is apparently dependent upon atomic collapse, and (3) the radiation of gaseous substances, dependent almost entirely upon normal atomic structure, and possibly also upon the mode of excitation

The subject to which consideration is now invited has to deal only with radiation of this third class Radiation which in terms of the electron theory is said to be due, not to abrupt or discontinuous acceleration, but to periodic acceleration

Briefly defined, spectroscopy is that science which has for its object the general description of radiation including the production of radiation, the analysis of radiation the registration of radiation, and the measurement of radiation

The theory of separating, recording, and comparing radiation is by no means simple or complete That these last three operations demand in practice the highest degree of skill is exemplified by the work of Rayleigh, Rowland, Michelson, Perot and Fabry, and Hale

There is however, a certain very true sense in which these last three processes are merely preparatory to a more profound study of the first, namely the production of radiation From this point of view, spectroscopy hinges upon the radiant atom—if there be an atom—and may be defined, imperfectly and narrowly perhaps, as *the science of the radiant atom*

More than one brilliant and partially successful attempt has been made within the last quarter-century to establish an adequate foundation for this science by devising what may be called a satisfactory atom But before considering any of these attempts, it may be well to state briefly what seems to be the criteria by which any such foundation is to be judged

Perhaps it may be fair to consider that atom is most competent which will explain satisfactorily the largest number of the following nine facts —

[1] From an address delivered by Prof W S Eichelberger chairman of the Section of Mathematics and Astronomy

[1] From an address delivered by Prof H Crew, chairman of the Section of Physics

(1) The fact that spectral lines are in general approximately sharp

(2) The fact that spectral lines are never perfectly sharp but always have a finite physical width

(3) The fact that certain spectral lines are arranged in series and bands after the manner described so perfectly by Balmer's equation and its generalised forms

(4) The fact that increase of pressure causes a shift of spectral lines toward the red, as discovered by Humphreys and Mohler

(5) The fact that a magnetic field will transform single lines into multiple polarised lines, as discovered by Zeeman

(6) We come now to a group of phenomena which are not easily described under a single caption I refer to phenomena such as those observed by Plucker and Hittorf when they found one and the same gas in one and the same tube yielding very different spectra according to the mode in which the electric discharge was applied to make the gas luminous In the same category doubtless belongs the extinction of air lines by the insertion of self induction into the discharge circuit Here may belong also the fact studied by Lenard and others that the region near the electrode of an arc gives a spectrum different from the region near the centre of the arc, the fact also that the so-called 'spark lines' are introduced into an arc by reducing the current to small values, a fact first studied by Hartmann

Certainly in this same category belongs the fact that the spectrum of an arc is modified when the arc is surrounded by an atmosphere different from ordinary air

Here also lie the profound differences between arc and spark spectra of the same element

Notwithstanding the fact that 'multiple spectra' is a term which has hitherto been employed to describe the Plucker tube variations I propose that we generalise it and use it to describe this entire group of facts Since the name is so appropriate let us call the sixth fundamental phenomenon that of "multiple spectra"

(7) Any competent atom must allow us to infer the relations which have been proved to exist between spectral phenomena and atomic weights

(8) The phenomena of line reversals and absorption bands

(9) The fact that heat alone at least within the range of our highest artificial temperatures produces characteristic spectra in only a few rare instances

These briefly are the parts of the spectroscopic superstructure for which a foundation is sought These are the various parts which it is hoped will, some day, be cemented together by a simple and general theory, into a harmonious structure

But there is a final criterion even more fundamental than any of those which have been mentioned that such a theory must satisfy, namely this hypothetical radiant atom must not in its behaviour except as a very last resort contradict any of the established principles of physical science be they mechanical electrical, or chemical

The principle of the conservation of energy must be satisfied even if it is necessary to assign an undreamed of amount of energy to each atom in like manner Newton's third law is to be satisfied even if the electromagnetic ether is called upon to furnish the reaction

But even with this added criterion the preceding list of nine phenomena is confessedly incomplete the only object of such a catalogue is to include those typical fundamental facts which ought apparently, to follow as immediate consequences from the structure of the radiating body so soon as that structure is correctly guessed Thus Doppler's principle is omitted on the ground of its being rather a kinematic law governing periodic disturbances in any medium than a dynamical fact to be explained in terms of atomic structure and forces

Having established a set of criteria by which we may estimate the fitness of a radiant atom, it would be interesting, if I were competent, and if time permitted, to pass in review some of the various atoms which have been proposed in recent times, such as that of Kelvin, 1884, or those suggested by the Hertzian oscillator

But neither of these two conditions are fulfilled and I propose, therefore to consider only one atom, namely, the one which by common consent, I think I may safely say, more nearly satisfies the demands of experimental fact than any other ever devised I refer to the atom first proposed in a general way by Lord Kelvin in his paper entitled "Epinus Atomised" (Baltimore Lectures, p 541, Cambridge, 1904), and afterwards profoundly modified by Lorentz, Thomson, and Larmor

So much work along this line has been done in the Cavendish Laboratory that one feels impelled to call this 'the Cambridge atom", in view, however, of its structure perhaps "the Saturnian atom" is a more appropriate designation

THE CONTRIBUTIONS OF AMERICA TO GEOLOGY[1]

In speaking of the contributions of America to geology, I do not propose to give an inventory of the geological facts which have been made known as the result of work in this country I propose rather to ask the question, 'What has our country contributed to the stock of geological ideas?" In that classical history of geological science which Lyell has given us in his "Principles of Geology," he directs attention to the fact that the share which different nations bore in the early development of geological science was dependent, not alone upon the genius of individual workers but in large measure upon the peculiar geological conditions of the various countries in which they worked

Of course, it must be admitted that there is to-day no department of geological science which is as characteristically American as mineralogy was German, as dynamical geology was Scotch, as stratigraphical geology was English, and as palæontology was French a century ago I believe, nevertheless, that there have been certain contributions to the stock of geological ideas which are characteristically American

The doctrine of the permanence of continent and ocean —the gradual emergence of continental lands and the withdrawal of the waters into the deepening ocean basins—was first enunciated by Dana in 1846 It was, apparently, the thought of the subsiding ocean bottom rather than the thought of the emerging land by which Dana was first led to the doctrine of the permanence of continent and ocean but in his presidential address before the American Association for the Advancement of Science in 1855, Dana refers to the stratigraphy of New York as illustrating the idea of continental emergence The doctrine of the permanence of continents when announced by Dana was essentially a new one Geologists and pseudo-geologists of all classes had felt at liberty to redistribute continents and oceans according to their own sweet will

There is now little doubt that Dana was right in his general conception The greater density of the suboceanic masses in comparison with the subcontinental masses, as shown by pendulum observations, indicates that the distinction between continent and ocean has its basis in the heterogeneity of the material in the interior of the earth, and the determining conditions must therefore have had their origin in the initial aggregation of that part of the primitive nebula which formed the earth

Certain it is however that Dana made the evolution of the continents too simple an affair He recognised indeed, that the progressive emergence of the continental lands was attended by continual oscillation, yet, even in the last edition of his "Manual" it appears that he did not duly appreciate the magnitude of those oscillations The doctrine of the progressive evolution of continents, as taught by Dana gave new clearness and emphasis to the general conception of geology as a history of the globe

The Geological Survey of Pennsylvania made known the folded structure—the alternate anticlines and synclines—of the Appalachians The beautiful sections of these folded strata, in the atlas of that survey, reveal the thoroughness with which the structure of the mountains was investigated by Henry D Rogers

While the stratigraphy was worked out so beautifully in the first geological survey of Pennsylvania the dynamic conception derived from it was crude indeed But, however completely the Pennsylvania geologists failed to con-

[1] From an address delivered by Prof Wm North Rice, chairman of the Section of Geology and Geography

struct a satisfactory theory of mountain-making, their observations of Appalachian structure were of immense value in their destructive effect upon some of the notions of mountain-making prevalent at the time.

The true interpretation of the Appalachian waves is probably to be found in the contractional theory of mountain elevation, of which Dana was the leading expounder. That the main cause of mountain elevation is tangential pressure in the crust resulting from internal contraction is now generally acknowledged, though there may be doubt whether the main cause of contraction is the cooling of the earth from an incandescent condition.

It is a curious fact that the first published suggestion of the agency of ice in connection with the drift came from a cotton manufacturer in Connecticut, Peter Dobson by name. The credit of the introduction and championship of the glacier theory of the drift belongs, not to a native, but to an adopted citizen of this country. In the early papers of Agassiz, the conception of the Glacial period took a form which he himself later recognised as an exaggeration. He conceived at first a fall of temperature so widespread that a polar ice-cap extended southward over the whole breadth of Europe and across the Mediterranean, reaching the Atlas Mountains. Later he recognised the ice-sheet that covered the Alps as entirely separate from the ice-sheet of northern Europe. The tendency to an exaggerated view of the Glacial period overcame him again in later years, when he maintained that at the climax of the Glacial period there was "floating ice under the equator, such as now exists on the coasts of Greenland." As Agassiz travelled in various parts of his adopted country, he recognised everywhere in the northern States the traces of glaciation already familiar to him in Switzerland and in Scotland.

Within the last few decades the labours of earnest and able investigators have developed the glacier theory more in detail, and have added vastly to our knowledge of Quaternary history. The imaginary polar ice-cap has given place to ice-sheets of more limited dimensions, though still vast. The series of terminal moraines, marking stages of re-advance or halts in the retreat of the ice-sheet, have been carefully mapped.

In early years the study of geology in this country was substantially confined to the region east of the Mississippi; but, in due season, the weird and fascinating region of the Cordillera revealed itself to explorers and geologists. It is now more than half a century since American geologists began the study of that western wonderland. The first lesson that geologists learned in that land was the efficiency of subaerial denudation to remove vast quantities of material and shape the topography of wide areas. That western land has taught us, not only to recognise the fact of subaerial denudation, but also to formulate its methods. In Powell's "Exploration of the Colorado River," he distinguished rivers as consequent, antecedent and superimposed. Davis has carried the analysis somewhat further, giving us subsequent and obsequent rivers. Powell formulated the doctrine of base-levels; Davis has given the conception greater accuracy and consistency by distinguishing base-level from profile of equilibrium. To Davis also we owe the full development of the conceptions of youth and age in river valleys and in drainage systems, and of cycles of erosion ending in the formation of peneplains.

Half a century ago the exploring expeditions connected with the Smithsonian Institution began to collect fossils from the Tertiary deposits of the western plains. Over those western plains were found to stretch vast continental deposits, certainly not all of lacustrine origin. These continental deposits of the western plains yielded in unparalleled richness mammalian fossils, which have been studied by Leidy, Marsh, Cope, Osborn, Scott, Wortman and others. No other single series of discoveries has been so potent in changing the bearings of palæontology upon the doctrine of evolution.

In the half-century since the publication of Darwin's first edition, the attitude of palæontologists has completely changed. Not only is it true at present that palæontologists are substantially unanimous in accepting the doctrine of evolution, but it has come to be generally believed that the very science which afforded a half-century ago the strongest objection to evolution now affords its strongest support.

When the first edition of the "Origin of Species" was published, the classes of birds and reptiles seemed to stand widely asunder. But in the very next year (1860) an odd feather of Archæopteryx was discovered, and a year later the skeleton now preserved in the British Museum; but Archæopteryx was a solitary representative of the birds of markedly reptilian character until the discovery of Ichthyornis and Hesperornis in the Cretaceous of Kansas, of which preliminary descriptions were published by Marsh in 1872.

But the discoveries of most evolutionary significance, as already intimated, have been among the Tertiary mammals. A number of series has been traced leading from generalised types in the Eocene through forms of gradually increasing specialisation, to genera which still survive.

SOME PHASES OF PREHISTORIC ARCHÆOLOGY.[1]

Are eoliths artifacts? This is the fateful question. Their geological age is of no consequence if they are only natural forms and have never been used by man or his precursor. The first flakes to be utilised were in all probability natural forms. It is not likely that Eolithic man knew how to obtain the raw material from the chalk. He depended on picking up from the drift flakes of approximately the shape and size needed. A sharp edge was utilised once, twice, or until it became dulled, and was then cast aside. If an angular piece did not admit of being comfortably grasped in the hand, the troublesome corners were removed. Such conclusions as these are forced upon one after careful examination of a series of the specimens in question. Would the same conclusions be so irresistible if these objects were merely nature's playthings? Many may even be grouped according to more or less definite patterns. Two of these deserve special mention, viz. the small crescent-shaped scrapers comparable to the spoke-shave, and the double scrapers with an intervening point between the two scraping edges. Sometimes two margins are worked but on opposite sides; that is to say, after chipping one of the margins, instead of rotating the specimen until the adjacent margin comes into play, it was reversed.

The wide differences of opinion as to the origin of eoliths can hardly be due to prejudice alone. Faulty or insufficient observation and incorrect interpretation doubtless play their part. Luckily there is no disposition to drop the matter until the truth appears. At the International Congress of Anthropology and Prehistoric Archæology held at Monaco April 15–22, 1906, the chief subject of the second session was the pedigree of the eolith. According to NATURE (June 28, 1906, p. 211), "a series of mill-modelled flint nodules was exhibited, among which there was certainly a number closely resembling many Prestwichian types, but conspicuous by their absence were the decidedly purposeful and rationally usable Kentian forms." On the other hand, Prof. E. Ray Lankester "submitted that he had recently placed on exhibition in the British Museum a considerable series (*Amer. Anthropol.* (N.S.), 1905, vii., 432, 433) of specimens selected from Prestwich's collection, all borer-like in form, too identical in shape and so rationally of obvious utility for any possibility of their being the result of fortuitous natural collisions."

As a further indication of the importance attaching to a correct solution of the problem, and indirectly in recognition of the value of Rutot's contribution toward such a solution, the meeting of the German Anthropological Association for 1907 will be held in Cologne in order that the members may visit the eolithic stations of Belgium and see the collections of the Brussels Museum.

Of caverns with Palæolithic mural decorations outside France, thus far reported, one is in Italy and four in Spain. The most important cavern in the Spanish group is that of Altamira, in the north coast province of Santander, this being the one in which the discovery of mural figures first took place. The genuineness of these figures would have continued to remain in doubt

[1] From an address delivered by Prof. MacCurdy, chairman of the Section of Anthropology.

had it not been for similar subsequent discoveries elsewhere.

M. Émile Cartailhac and the Abbé H. Breuil have recently studied with great care the wall paintings and engravings at Altamira. The cavern is a series of large chambers connected by passage ways. There is no evidence of its having been occupied by either man or beast since the close of the Quaternary, at which time the entrance was completely closed by a fall of earth and stones.

A second recent fall has afforded a new opening to the cavern, reached by clambering over the débris that closed the original entrance. The first chamber is divided by means of a mass of fallen stones. The one on the left is 40 metres long by 20 metres wide. The one on the right is a sort of corridor connecting with other chambers. Industrial remains of the floor deposits are confined to the entry and the chamber on the left. There is evidence that the cave bear had occupied the cavern before man took possession. Figures, engraved or painted, are found on the walls of every part of the cavern, especially on the ceiling of the chamber on the left near the entrance, where the frescoes are remarkable for their beauty, size, and good preservation—a sort of Sistine chapel representing the *chef d'oeuvre* of perhaps more than one Michael Angelo of that far-off time.

These works of art represent a variety of technique. Some are simple line engravings. Others are more deeply incised. But the engravings are not so numerous as the figures represented in colour. Many are done in a single colour, either red or black. The most remarkable are the polychrome frescoes similar to those of Font-de-Gaume already described.

The figures are not all animal representations. Many are signs the significance of which is not known. They do not belong to a single epoch. The superposition of figures, each in a different technique, studied in connection with the relative state of preservation of the various figures, has furnished a key to the order of succession. The same succession is traceable in the caverns of France, so that the Abbé Breuil and his colleagues MM. Cartailhac, Capitan, Peyrony, and Bourrinet have been able to distinguish four distinct phases[1] in the evolution of mural painting and engraving, all of them being represented in the cavern of Altamira.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following Graces passed the Senate at Congregations held on February 1 and 2:—(1) That in accordance with recommendation i. contained in the third report, dated November 15, 1906, of the special board for mathematics on the mathematical tripos, the regulations for the mathematical tripos, part i., contained in the report be approved (placet, 776; non-placet, 644). (2) That in accordance with recommendation ii. of the same report, the regulations for the mathematical tripos, part ii., contained in the report be approved (placet, 780; non-placet, 638). (3) That in accordance with recommendation iii. of the same report, the temporary provisions for the mathematical tripos, alike under the old regulations and the new regulations, contained in the report, be approved (placet, 777; non-placet, 637).

The Adams prize for 1907 has been awarded to Dr. E. W. Brown for his essay on "The Inequalities in the Moon's Motion due to the Direct Action of the Planets."

Mr. Douglas W. Freshfield will deliver a public lecture on Ruwenzori at the Sedgwick Museum on Thursday, February 14. The lecture will be illustrated by lantern pictures, including many taken during the Duke of the Abruzzi's expedition.

The special board for biology and geology has nominated Mr. C. Shearer, Trinity College, to use the University table at Naples for three months from March 1.

MR. FRANCIS GALTON, F.R.S., has given a further sum of 1000*l.* to the University of London in aid of the study of national eugenics founded under his previous benefaction. Mr. David Heron has been appointed Galton research fellow in national eugenics, in succession to Mr. Edgar Schuster, resigned.

SIR COWASJEE JEHANGHIR READYMONEY has, says the *Times*, offered to the Bombay Government the sum of 2½ lakhs of rupees (16,666*l.*) for the erection of a university examination hall in Bombay, thus following the munificent example of his father in giving to the city the Elphinstone College buildings and the Senate hall of the University.

THE annual general meetings of the Association of Technical Institutions will be held at the Clothworkers' Hall, Mincing Lane, E.C., on Friday and Saturday, February 8 and 9, as follows:—on Friday afternoon the presidential address will be delivered by Sir Horace Plunkett, K.C.V.O. On Saturday morning the following papers will be read and discussed:—the cooperation of adjacent authorities in the supply of higher technical education, Principal A. F. Hogg; monotechnic institutions, Mr. Charles Harrap.

SIR A. B. W. KENNEDY, president of the Institution of Civil Engineers, speaking at a dinner given by the Carpenters' Company on Monday to a number of eminent members of the engineering profession, remarked that the idea of thirty or forty years ago that the training of an engineer should be specialised has passed away. It is now recognised by all engineers that their profession is one at bottom, and that therefore an engineer should have a thorough general training in scientific work which should be the basis of all his future work, and that he should only specialise when it is necessary to do so to earn his daily bread.

THE inaugural lecture to the courses on Japanese education, to be delivered under the Martin White benefaction in the University of London by Baron Dairoku Kikuchi during the spring and summer terms, will be given at the University, South Kensington, on Thursday, February 14, at 5 p.m. Sir Edward Busk, Vice-Chancellor of the University, will preside. Admission to the inaugural lecture will be free by ticket, obtainable on application to the academic registrar at the University, South Kensington. Arrangements have been made for a course on Japanese educational administration to be delivered at the London School of Economics, and for courses on Japanese educational methods to be delivered at University College, Gower Street, and King's College, Strand.

THE annual court dinner of the Leeds University was held on Thursday, January 31, and was attended by His Excellency Baron Komura, the Japanese Ambassador to this country, as the chief guest. Among those present were the High Sheriff of Yorkshire, the mayors of many neighbouring boroughs, representatives of various education authorities, technical institutions, grammar schools, and other bodies. Baron Komura, in proposing the toast of the University, referred to the debt of gratitude which Japan owed to the educational institutions of England, and among them to the University of Leeds, which has numbered a good many young Japanese amongst its students. Since the granting in 1904 of the Charter establishing the University, a new capital fund has been raised by private donations which now amounts to 82,300*l.* New buildings are in progress to accommodate the department of mining and metallurgy, and other important extensions rendered necessary by the growth of numbers in the University are under consideration.

THE council of the University of Manchester has decided to institute two new lectureships, one in economic zoology and one in economic botany. The lectureship in economic zoology will provide further instruction in special subjects for the senior and honours classes in zoology, and the lecturer will devote a portion of his time to the preparation of reports on animal parasites and pests. An important part of the duty of the new lecturer will be to conduct research on such subjects as the fauna of reservoirs and sewage conduits, the life-history of animal parasites, and on other matters of economic importance. The lecturer in economic botany will give instruction to

[1] A fifth and closing phase is discernible at Marsoulas, resembling somewhat the work on the painted pebbles of Mas d'Azil.

special classes, and will assist in arranging and making accessible to students and to the public the collections of plants and plant products possessed by the University. It will also be his duty to examine and report upon such specimens of plant diseases, of timbers, and of other vegetable products, as may be sent to the University and to the Manchester Museum for identification, and to conduct special researches in economic botany.

THE annual distribution of prizes and certificates to the successful students attending the colleges and schools conducted in London by the City and Guilds of London Institute, was held at the Mansion House on January 31. The Lord Mayor presided. Sir Edward Busk, Vice-Chancellor of the University of London, in the course of an address referred to the suggestions of the departmental committee of the Board of Education for the amalgamation of the Royal College of Science, the Royal School of Mines, and the Central Technical College at South Kensington in one great technical college. He sees no reason why such a scheme cannot be carried out. The Royal College of Science would be the nucleus of the scientific side of such a technical college, and the Central Technical College would be the nucleus of the engineering side. He earnestly hopes that the governing body of the new institution will take measures to ascertain that candidates for admission already possess a sound general secondary education. At present the students who come up have not sufficient general knowledge and culture. Sir J. Wolfe Barry, in proposing a vote of thanks to Sir E. Busk, expressed the hope that a start would soon be made with the development at South Kensington of a great college for technical education.

AMONG the most recently announced gifts to American seats of higher education may be mentioned the following, recorded in *Science*. As already announced by cable (p. 237), Mr. J. D. Rockefeller has given the University of Chicago 540,000*l*. for its permanent endowment, and 43,400*l*. for current expenses and special purposes. Among the special provisions of this latter gift is one to provide permanent increases in the salaries of instructors, 8000*l*. Mr. Rockefeller's gifts to the University of Chicago are said to amount to more than 4,000,000*l*. It is announced that 65,000*l*. have been subscribed toward the 100,000*l*. endowment which is being raised to mark the seventy-fifth anniversary of Lafayette College. Of this sum, Mr. Andrew Carnegie has given 10,000*l*. for a mechanical engineering course. He will give an additional 10,000*l*. provided the 100,000*l*. is obtained. A further gift of 10,000*l*. from Mr. Andrew Carnegie to Bates College is announced. Mr. Carnegie's offer of this amount stipulates that friends of the institution shall subscribe 20,000*l*., and this amount has been secured. Mr. Carnegie has also given 150,000*l*. for the construction of a building to be used by the Bureau of American Republics. Provision for the site already has been made by the United States and the South American Republics.

A LONG communication to the *Times* by Mr. A. Mosely again directs attention to American methods of education. Mr. Mosely recently returned from the United States and Canada, where he went to prepare for the arrival of British teachers who are now at work visiting American schools and studying Western systems of education. He tells a gratifying story of the kindness of the welcome accorded to the visitors. The interchange of views between two great English-speaking peoples must be of enormous benefit to those who are trying to work out practical systems for the education of future generations. Already the British teachers have been impressed with the great belief in the value of education shown by Americans. Mr. Mosely points out that this belief in education finds a ready echo amongst all classes of society, who are prepared to pour out money, both through taxation and by princely gifts for education. The material advantage of the American system of education is manifesting itself by the prosperity of the country and by the flow of inquiries at the doors of every university and place of higher education for the services of the students as they graduate. In fact, there are many applications for every pupil available. One of the most noticeable features in the United States is, the letter continues, the desire of the pupil, ably backed by the parent, to take full advantage of the magnificent system afforded by the country of practically free education from the kindergarten to the university.

THE final report of the Royal Commission on Trinity College, Dublin, and the University of Dublin has been published. The recommendations of the commissioners and the decision of the Government as announced by Mr. Bryce in reply to a deputation on January 25, have given rise to much discussion. The difficulty in connection with the establishment of a satisfactory system of university education in Ireland is a religious one. As the first conclusion of the commissioners states, Trinity College has been and is a satisfactory organ for the higher education of the Protestant Episcopalian population of Ireland, but it has never been and is not now to an extent adequate to the reasonable requirements of the country, an organ for the higher education of the Roman Catholic population. The important matter is somehow to secure for all Irishmen who desire it the benefit of university education, and, in view of this paramount necessity, we welcome the scheme outlined by Mr. Bryce as being likely to consolidate educational effort and to free institutions of higher instruction from impediments arising from sectarian animosities. The Government appears to have decided that the University of Dublin shall be enlarged so as to become a national university for Ireland, which will include as constituent colleges—Trinity College, a new college in Dublin, and the Queen's Colleges in Cork and Belfast. In regard to the new college, it is to be furnished with adequate buildings and laboratories, and it is hoped that on the science side use may be made of the Royal College of Science, and that its laboratories and apparatus will be the means of effecting the change economically. The funds at present used by the Royal University—which is purely an examining body—are to be employed for the purposes of the new college and the proposed University of Ireland generally. It is intended that the new university shall be absolutely unsectarian, and that there shall be no tests for governors, fellows, teachers, students, or examiners. Though there are signs already that the proposals of the Government will in some quarters meet with great opposition, we are hopeful that it will prove possible to establish in Ireland a comprehensive university which will include eventually every Irish seat of learning reaching a proper university standard.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 22, 1906.—"The Relation of the Kidneys to Metabolism." By F. A. **Bainbridge** and A. P. **Beddard**. Communicated by Prof. E. H. Starling, F.R.S.

The effects of removing the greater part of the total kidney weight of cats were studied; a portion of one kidney was removed at one operation, and some weeks later the opposite kidney was removed. After the second operation the animals refused food and lost weight, though not more rapidly than normal cats kept for twenty-four hours without food. The increased output of urinary nitrogen described by Bradford was not invariably observed, but in some cats which refused food after the second operation the output of nitrogen was increased, though not to the amount found before the second operation. Moreover, the output of urinary nitrogen did not rise until the animals had lost about 25 per cent. of their body weight. A similar rise of nitrogen has been found by many observers in normal animals when the body fat has been largely used up and energy has to be supplied by increased proteid katabolism. It may be concluded, therefore, that the increased output of nitrogen observed in cats deprived of three-quarters or more of their kidneys is the result of inanition; no evidence was obtained that the kidneys directly influence nitrogenous metabolism.

Bradford found that dogs, after excision of part of one kidney, were apparently unable to pass a concentrated urine. The authors find, however, that under the same

conditions cats can still pass a concentrated urine and that its amount is not greater than normal Even after the second operation the urine is not excessive in amount or notably dilute Retention of nitrogen always occurred after the first operation, and in one animal after the second operation also **Analysis**, by Schryver's method, of the blood liver, and muscles showed by comparison with normal animals, a marked increase not only in the actual amount of residual nitrogen in these organs, especially the liver, but also in its percentage relatively to the total nitrogen

December 6 1906—"On the Transpiration Current in Plants" By Prof H H **Dixon**. Communicated by Prof J Joly, F R S

The adequacy of the theory which attributes the rise of water in trees during transpiration to the traction transmitted downwards in the water columns has been questioned by several different investigators These objections, which have been based on an erroneous view as to the effect of the presence of undissolved gas in the water-ways or of dissolved air in the water itself have already been disposed of A more recent criticism maintains that the resistance offered to the transpiration current by the conducting tracts of trees is so great that the forces generated in the leaves are inadequate to raise the water, and that even if these sufficed air-containing water could not transmit the tensions involved, and hence it is imperative to assume lifting mechanisms located in the water ways in order to account for the upward movement of water in trees

In the present paper it is pointed out that the advocates of this view have taken up their position partly owing to an overestimate of the velocity of the transpiration current but principally owing to an excessive evaluation of the resistance of wood to the flow of water

With regard to the methods employed by the critics of the cohesion theory to determine the velocity of the transpiration current the author points out that cut branches supplied with colour solutions draw up these solutions not only unretarded by the resistance of the lower parts of the stem but actually with the assistance of the atmospheric pressure There is also reason to believe that the velocity in the lower parts of the branches which is the velocity observed in these experiments, is greater than that in the more distal parts Hence the observation of the rate of the rise of the colour-solution, according to this method tends to give an exaggerated idea of the velocity of the water current in intact trees As to the second method employed for estimating the velocity of the current it is shown experimentally that the transpiration of isolated branches enclosed in desiccated chambers does not give a fair indication of the total amount transpired by all the branches of a tree but again tends to give excessive results This is evident immediately when we consider that the desiccated branch is able to draw on the water store of the whole tree

The paper also contains the record of numerous experiments carried out with the view of determining the resistance offered by the water-conduits of plants to the flow of water under various heads, and it is shown that the velocity which is directly proportional to the head is in the case of the yew between 7 cm and 9 cm per hour when the head is equal to the length of the transmitting piece of wood According to the recent criticism of the cohesion theory, to produce such a velocity would require a head equal to almost six times the length of the water conduits Hence the objection that to raise the sap in trees 150 metres high would require tensions approximating to 100 atmospheres, based as it is on this estimate, is without foundation In reality the cohesion theory would demand, if, indeed the excessive velocities before alluded to are assumed throughout the water ways of high trees, that osmotic pressures approaching 30 atmospheres should be available in the cells of the leaves Pressures of this magnitude have been observed in the leaves of less lofty plants

The discrepancy between the results of the observers quoted and those recorded in the paper are possibly partially due to the use of higher pressures by the former which tend to exaggerate the errors due to the inevitable clogging at the cut surfaces In this connection, a method is described by which this error may be eliminated when determining the amount of water transmitted through a cut branch

In conclusion, it is pointed out that not only is the cohesion theory in accordance with the most trustworthy observations, but the fact that other theories, both old and new, have to assume properties for the water-ways of plants which are either in the highest degree improbable according to received scientific views, or are even directly negatived by experiment, seems to support the theory by a process of exclusion

Chemical Society, January 17—Prof R Meldola, F R S, president in the chair—The relation between absorption spectra and optical rotatory power, part i, the effect of unsaturation and stereoisomerism A. W **Stewart**. A close relation is shown to exist between the general absorptive power of compounds and their molecular rotation, the substance having the greater general absorption having also the greater molecular rotation—Organic derivatives of silicon part ii the synthesis of *dl* benzylethylpropylsilicol, its sulphonation, and the resolution of the sulphonic derivative into optically active components F S **Kipping** *dl* Benzylethylpropylsilicol yields with sulphuric acid a mixture of sulphonic acids of which one has been isolated in the form of its ammonium salt This acid probably has the constitution

$SO_3H\ C_6H_4\ CH_2\ SiEtPr\ O\ PrEtSi\ CH_2\ C_6H_4\ SO_3H$,

and is the externally compensated compound The *d*-methylhydrindamine salt can be resolved by crystallising fractionally from aqueous methyl alcohol—The association of phenols in the liquid condition J T **Hewitt** and T F **Winmill** The authors have determined the surface energy of several liquids and find that the association of phenols is diminished or entirely inhibited by the presence of ortho substituents This effect of steric hindrance is also seen with the aromatic alcohols—A new mercuric oxychloride J T **Hewitt**. On allowing solutions of sodium hydroxide and mercuric chloride in sodium chloride to diffuse into one another, through a layer of sodium chloride solution of intermediate density, dark red crystals having the formula $Hg_6O_5Cl_2$ are deposited—Preparation of chromyl dichloride H D **Law** and F M **Perkin** Chromic acid is dissolved in concentrated hydrochloric acid, and sulphuric acid added in small quantities The chromyl dichloride formed is drawn off and purified by aspirating dry air through it and subsequent distillation—Oxidation of hydrocarbons of the benzene series H D **Law** and F M **Perkin** The hydrocarbons investigated were toluene the three xylenes mesitylene, ψ-cumene, and cymene In all cases varying yields of the monoaldehydes were obtained—The constitution of silver nitrite, a correction E **Divers**—Aromatic selenonium bases S **Smiles** and T P **Hilditch** Trianisyl- and triphenetyl-selenonium chlorides and some of their derivatives are described—The relation of colour and fluorescence to constitution A G **Green** A study of the phthaleins of phenol and quinol, which the author has had in progress for some time past has brought to light several facts strongly confirming the view that the coloured salts of these phthaleins have a quinonoid structure, thus rendering Silberrad's deductions as to the structure of these bodies unnecessary (Journ Chem Soc, 1906, lxxxvii 1787)—Tetraketopiperazine A T **de Mouilpied** and A **Rule**.—Transformations of highly substituted nitroaminobenzenes ii, *s*-tribromo-*l*-nitroaminobenzene Miss A E **Smith** and K J P **Orton**.—Resolution of tetrahydro-*p*-toluquinaldine into its optically active components T C **Beck** and W J **Pope**. By treating two equivalents of *dl*-tetrahydro-*p*-toluquinaldine hydrochloride with one equivalent of the ammonium salt of Armstrong and Lowry's *d*-$\alpha\beta$-bromocamphorsulphonic acid under appropriate conditions, a nearly quantitative separation of *d* tetrahydro-*p* toluquinaldine-*d*-$\alpha\beta$-bromocamphorsulphonate is obtained—Note on the theory of valency W **Barlow** and W J **Pope**. A reply to Chapman (Proc Chem Soc 1906, xxii, 320)—The condensation products of triacetic lactone with acetoacetic ester and β-aminocrotonic ester F N A **Fleischmann**.—Derivatives of multivalent iodine, part ii, action of heat on *p*-iodoacetophenone dichloride,

p-iodoacetanilide dichloride, and on the dichlorides derived from *o*-, *m*-, and *p*-iodotoluene W **Caldwell** and E A **Werner.**—Disalicylamide J **McConnan**—Benzoyl derivatives of *N*-methylsalicylamide J **McConnan** and M E **Marples.**—The velocity of reaction of bromine with some unsaturated acids in aqueous solution E **Barrett** and A **Lapworth.** The authors have been engaged in the examination of addition of bromine to some unsaturated acids in aqueous solutions in the hope of throwing some light on the mechanism of such reactions The results of experiments with cinnamic, benzylidenemalonic acid and β-bromocinnamic acids are described They appear in consistent with the view that bromine dissociates into ions before addition at a double linking, and seem to show that the ions of the acids, as well as the acids themselves, unite with bromine directly —Note on the molecular complexity of liquids A E **Dunstan** and F B **Thole** A criticism of Holmes's results (Journ Chem Soc, 1906 lxxxix, 1774)

Zoological Society, January 15 —Dr J Rose Bradford, F R S, vice-president, in the chair —A new monkey from the Ituri Forest, obtained during the recent Ruwenzori expedition Oldfield **Thomas**—The "bleating" or "drumming" of the snipe (*Gallinago coelestis*) P H **Bahr** The object of the paper was to prove that this phenomenon was produced by the tail-feathers of this species, a point which had been much disputed It was found that if the feathers were attached to a cork in a special manner, the peculiar bleating sound could be produced, and, furthermore, that only two feathers in this species were the active agents in producing the sound Observation proved that these two feathers were held in a particular manner in front of the others during the bird's flight in the breeding season Feathers of both male and female were found to bleat, a fact which had been borne out by numerous observers in the field These feathers were found to have a peculiar structure, differing materially from that of the other feathers in the tail Microscopically they differed, and the number of hamuli was found to be in excess of those found in other feathers The feathers of various exotic species had been experimented upon, and those of *G delicata G nobilis G frenata G paraguayae* in the New World, *G australis* and *G aucklandica* in the Antipodes, and *G solitaria* and *G megala* in Asia, had been found to produce musical sounds These feathers varied in structure, and consequently the sound produced differed accordingly The feathers of *G gallinula, G major*, and *G stenura* were not found to be musical —A collection of mammals from Annam sent home by Dr Vassal J L **Bonhote** Twenty-four species were enumerated, of which the following four were described as new —(1) *Nycticebus pygmaeus*, sp n, (2) *Lupaia concolor* sp n, (3) *Sciurus leucopus fumigatus* subsp n (4) *Funambulus rufigenis fuscus* subsp n Descriptions of seven new or little known species of marmoset monkeys from the Amazonian region Dr E A **Goeldi.**—Contributions to the knowledge of the systematic arrangement and anatomy of certain genera and species of Squamata F E **Beddard.**—A list, with descriptions of the new species of Pyralidæ collected by Mr A E Pratt in British New Guinea in 1902–3 G H **Kenrick.**

Royal Microscopical Society, January 16 —Annual meeting —Dr Dukinfield H Scott F R S president in the chair —The president delivered his annual address, his subject being the flowering plants of the Mesozoic age in the light of recent discoveries

Geological Society, January 23 —Sir Archibald Geikie, Sec R S, president in the chair —The geology of the Zambezi basin around the Batoka Gorge (Rhodesia) G W **Lamplugh** with petrographical notes by H H **Thomas.** This paper contains an account of the physiographical and geological structure of the hitherto undescribed country bordering the Batoka Gorge, which was investigated by the author in 1905 under the auspices of the British Association An account of the results obtained by the author appeared in NATURE of November 30 1905 (vol lxxiii, p 111)

DUBLIN

Royal Dublin Society, December 18, 1906 —Prof J A McClelland in the chair —The principal lines of the spark spectra of the elements Dr J H **Pollok.** The paper gave a collected table of the principal lines of all the common and rare elements arranged in order of their wave-lengths, and described a convenient method of conducting spectrographic analysis with gold electrodes by photographing the electrodes first with a long slit, and then sparking the solution under examination with a short slit, giving long gold lines, with short lines between of the element or elements under examination Photographs of a number of spectra were given, with conspicuous gold lines marked upon them at convenient distances, to aid in identification —The quantitative spectra of iron, aluminium, chromium silicon, lime manganese, nickel, and cobalt Dr J H **Pollok** and A J G **Leonard** This paper showed the progressive disappearance of the lines of these elements on dilution of their solutions, and gave tables of the residuary lines

January 15 —Prof Sydney Young, F R S in the chair —Radium and geology Prof J **Joly** (see NATURE, January 24, p 294) —Method of finding the absolute dilatation of mercury Prof J **Joly.** A mercurial barometer is raised in temperature by a steam jacket, and the change of reading observed The construction is simple and such as to eliminate errors of increased vapour tension An accuracy of 0 4 per cent is attained with ordinary care in observation

PARIS

Academy of Sciences, January 28 —M A Lacroix in the chair —The mineralogical constitution of the recent cone of Mont Pelée A **Lacroix** Conclusions drawn from a study of a series of specimens collected by M Guinoiseau during a recent ascent of the new cone —The superiority of the expenditure of energy arising from a flesh diet with respect to the expenditure arising from a diet in which foods of ternary composition predominate Consequences from the point of view of the general theory of food A **Chauveau** A dog was submitted to diets in which meat fat, and sugar respectively predominated The respiratory exchanges of the animal were studied both during work and at rest and the results shown graphically —The propagation of quasi-waves of shock P **Duhem**—Researches on the orbit of the comet 1819 IV (Blanpain), and on the possibility of the capture of this comet by Jupiter L **Lagarde** A re-calculation of Encke's results It would appear to be a case of the transformation of an orbit originally parabolic into an elliptic orbit of slight eccentricity but, owing to the small number of observations taken and their moderate accuracy there is still some uncertainty —The coefficients of development of the perturbation function Armand **Lambert**—Spherical functions Emile **Waelsch**—The representation by points of the most general equation of nomographical order 3 Maurice **d'Ocagne**—The curvature of the envelopes in the most general movement of a solid body in space G **Koenigs**—The calculation of the compressibility of gases in the neighbourhood of atmospheric pressure by means of the critical constants Daniel **Berthelot** Two methods of reduction are compared that of Van der Waals and the same modified by the author and these are compared with the experimental figures The author also criticises the method of reduction employed by M Guye, and condemns it —The solubility of carbon in barium and strontium carbides H Morel **Kahn** With barium the amount of carbon dissolved varied with the time of heating from 1 25 per cent to 6 2 per cent, and analogous figures were furnished by strontium carbide —Copper metaphosphate A **Auger** Cuprous metaphosphate is formed by the action of metaphosphoric acid upon copper at a red heat On cooling, the cuprous salt is decomposed into copper and the cupric salt —The causes which modify the estimation of fluorine in mineral waters P **Carle** It is pointed out that negative results for fluorides in mineral waters are commonly due to errors in manipulation and in particular the method used for separating the silica It is found that a solution of carbonic acid under pressure is capable of dissolving appreciable amounts of finely divided calcium fluoride Fluorides are nearly always a con

stituent of mineral waters.—A new method of estimating the halogens in organic compounds by means of the metal ammoniums: L. **Chablay**. In previous papers the author has given an account of the action of the metal-ammoniums on various organic haloid compounds, and in this work it was noticed that the whole of the halogen remained after the reaction combined with the alkali metal. This fact has been utilised as the basis of a very neat method for determining halogens in organic substances. Full details are given, and numerous analyses establishing the accuracy of the method proposed.—The condensed chromium sulphates: Albert **Colson**.—Some derivatives of hordenine: F. **Léger**. A description of the preparation and properties of the neutral tartrate, compounds with methyl and ethyl chloride, ethyl bromide and iodide, benzoyl and cinnamyl hordenine, and other derivatives.—Acetyl nitrate: Amé **Pictet** and Eugène **Khotinsky**. This substance has been obtained by dissolving nitric anhydride in acetic anhydride and separating by fractional distillation under reduced pressure. The nitrate detonates violently when suddenly heated, and hence had to be analysed by indirect methods. Towards aromatic substances acetyl nitrate acts as a nitrating agent of great power; benzene, toluene, anthracene, and thiophene being nitrated at temperatures below 0° C.—Ethyl benzoylglyoxylate: A. **Wahl**. Ethyl benzoylacetate in ether solution is submitted to the action of well dried nitrous fumes, and the product distilled under reduced pressure. The reactions of the new α-diketone with piperidine, hydroxylamine, o-phenylamine-diamine, semicarbazide, aniline, and phenyl hydrazine were studied.—The volume variations of the nucleus of the chromatic mass and of the cell in the course of the development of the pollen of *Nymphaea alba* and *Nuphar luteum*: W. **Lubimenko** and A. **Maige**.—Two new antelopes from Central Africa, *Cephalophus centralis* and *Cephalophus aequatorialis*: Maurice **de Rothschild** and Henri **Neuville**.—The affinities of the Bradypodidae (sloths), and in particular of *Hemibradypus mareyi*, with the Hapalopsidae of the Santacruzian of South America: R. **Anthony**.—The toxic products of the organism (muscular extracts): MM. **Charrin** and **Goupil**. The properties of an aqueous extract of muscle vary with the pressure under which the juices are expressed.—The interpretation of certain facts of coloured vision: Adrien **Guébhard**. A criticism of a paper on the same subject by J. P. Fortin.

DIARY OF SOCIETIES

THURSDAY, FEBRUARY 7

ROYAL SOCIETY, at 4.30.—The Influence of Increased Barometric Pressure on Man, No. 3. The Possibility of Oxygen Bubbles being set free in the Body: Leonard Hill, F.R.S., and M. Greenwood, jun.—On the Combining Properties of the Opsonin of an Immune Serum: Prof. R. Muir and W. B. M. Martin.—Experiments made to determine the Condition under which "Specific" Bacteria derived from Sewage may be present in the Air of Ventilating Pipes, Drains, Inspection Chambers, and Sewers: Major W. H. Horrocks.—Observations on the Life History of Leucocytes. Part II., On the Origin of the Granules: C. E. Walker.

ROYAL INSTITUTION, at 3.—Standards of Weights and Measures: Major P. A. Macmahon, F.R.S.

LINNEAN SOCIETY, at 8.—*Papers*: New Plants from Malaya: Dr. Otto Stapf.—Tertiary Foraminifera of Victoria: the Balcombian Deposits of Port Phillip: F. Chapman.—*Exhibitions*: Specimens of *Chara ornithopoda*: H. and J. Groves.—Some Observations of Climbing Plants (with lantern slides): Rev. John Gerard.—Herbarium formed by A. Ruperti, 1698–1700: W. Rose Smith.

CHEMICAL SOCIETY, at 8.30.—On the Rapid Electroanalytical Deposition and Separation of Metals. Part 1., The Metals of the Silver and Copper Groups and Zinc: H. J. S. Sand.—The Alkaloids of Ergot: G. Barger and F. H. Carr.—Influence of Substitution on the Formation of Diazo-amines and Amino-azo compounds. Part vi., the Partially Methylated 4:6-Diamino-*m*-xylenes: G. T. Morgan and F. M. G. Micklethwait.—(1) The Reduction of Hydroxylaminodihydroumbellulone Oxime, (2) The Constitution of Umbellulone. Part ii., the Reduction of Umbellulonic Acid: F. Tutin.—Studies on Optically Active Carbimides. Part v., The Aryl Esters and the Amides of *l*-Menthylcarbamic Acid: R. H. Pickard and W. Oswald.—Some Constituents of Natural Indigo. Part i.: A. G. Perkin and W. P. Bloxam.—The Occurrence of Isatin in some Samples of Java Indigo: A. G. Perkin.—(1) On the Absorption Spectra of Benzoic Acid, the Benzoates and Benzamide; (2) The Absorption Spectra of Phthalic, *iso*Phthalic and Terephthalic Acids, Phthalic Anhydride and Phthalimide: W. N. Hartley and E. P. Hedley.—ααγ-Trimethyl and ααγγ-Tetramethyl tricarballylic Acids and αΔ-Dimethyl butane αβΔ-Tricarboxylic Acid: H. Henstock and C. H. G. Sprankling.—A Reaction of Certain Colouring Matters of the Oxazine Series: J. F. Thorpe.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Investigations on Light Standards and the Present Condition of the High Voltage Glow Lamp: C. C. Paterson. (Conclusion of Discussion).—Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps using Alternating Currents: H. F. Haworth, T. H. Matthewman, and D. H. Ogley.

FRIDAY, FEBRUARY 8

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—President's Address.—The Magnetic Fields and Inductive Coefficients of Circular, Cylindrical, and Helical Currents: A. Russell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction of a Swing Bridge on the Southwold Railway: Claude Pain.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—What Evolutionary Processes do the Mollusca show? B. B. Woodward.

MONDAY, FEBRUARY 11

SOCIETY OF ARTS, at 8.—Gold Mining and Gold Production: Prof. J. W. Gregory, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Round the North Magnetic Pole and through the North-west Passage: Captain Roald Amundsen.

TUESDAY, FEBRUARY 12

ROYAL INSTITUTION, at 3.—The Visual Apparatus of Man and Animals: Prof. William Stirling.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Note on a Dolmen at Presle, France: A. L. Lewis.—The Ethnology of Modern Egypt: Dr. C. S. Myers.

WEDNESDAY, FEBRUARY 13

SOCIETY OF ARTS, at 8.—Motor Omnibuses: Lord Montague of Beaulieu.

THURSDAY, FEBRUARY 14

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Purification and Testing of Selenium: R. Threlfall, F.R.S.—On the Specific Inductive Capacity of a Sample of Highly Purified Selenium: O. U. Vonwiller and W. H. Mason.—The Thermomagnetic Analysis of Meteoric and Artificial Nickel-Iron Alloys: S. W. J. Smith.—Investigation of the Law of Burning of Modified Cordite: Major J. H. Mansell, R.A.

SOCIETY OF ARTS, at 4.30.—The Practical Side of Famine in India: Sir Frederick S. P. Lely, K.C.I.E.

LONDON INSTITUTION, at 6.—Scientific Method: Prof. H. E. Armstrong, F.R.S.

ROYAL INSTITUTION, at 3.—The Minute Structures of Igneous Rocks and their Significance: Alfred Harker, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—Groups defined by the Order of the Generators and the Order of their Commutator: Prof. G. A. Miller.—On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of a Pellian: Dr. T. Stuart.—On Repeated Integrals: Dr. E. W. Hobson.—The Construction of the Line drawn through a Given Point to meet Two Given Lines: Prof. W. Burnside.

FRIDAY, FEBRUARY 15

ROYAL INSTITUTION, at 9.—Foraminifera: J. J. Lister, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.

SATURDAY, FEBRUARY 16

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 14, 1907

THE SCIENTIFIC WORK OF WILLARD GIBBS

The Scientific Papers of J. Willard Gibbs. In two volumes. Vol. i., Thermodynamics. Vol. ii., Dynamics, Vector Analysis, Light, &c. Vol. i., pp. xxviii+434, price 24s. net; vol. ii., pp. viii+284, price 18s. net. (London: Longmans, Green and Co., 1906.)

THESE two handsome volumes are a fitting memorial to one who carved out for himself a very remarkable niche in the temple of scientific fame. With the exception of his one published book on statistical dynamics, we have in these collected papers practically all that Willard Gibbs put into form suitable for publication. Compared with the literary output of the leaders of science of the passing generation, this is a very limited contribution if judged only in regard to quantity. But the quality and far-reaching importance of Willard Gibbs's work place it on an eminence of excellence comparatively rarely reached. This remark specially applies to his great papers on the equilibrium of heterogeneous substances, which with his other papers on thermodynamics constitute the first volume of 434 pages. All are agreed as to the supreme importance of the thermodynamic memoirs, which give to their author a unique place among those who have done most to establish and develop the principles of this fundamental part of the doctrine of energy. It is not quite the same with the papers which form the second volume, of 284 pages, although in these also the author's characteristic qualities of mind show themselves. There is always an originality of view and a logical severity of treatment which indicate that the author has well digested his material before putting it in printed form before the eye of the public. Nevertheless, even if we do not consider the contents of vol. ii. as attaining the same high average of excellence as the contents of vol. i., their comparative brevity makes good the claim that in Willard Gibbs we had a writer and thinker of very exceptional merit.

Unlike most young scientific men, Willard Gibbs was in no hurry to publish, his earliest papers dating from 1873, when he was thirty-four years of age. The second of these papers, that on thermodynamic surfaces, became speedily known to the scientific world through the pages of Maxwell's "Theory of Heat", and Maxwell was himself the first to construct a model of the volume-entropy energy surface. Copies of this model were distributed by Maxwell evidently with a certain amount of playful mystery, for each recipient thought that he was the happy possessor of one of (at most) three. The writer knows of six at least, and possibly there are more. We also owe to Maxwell a very clear, brief statement of the essential feature of the great papers on the equilibrium of heterogeneous substances. In spite of this, however, the immense value of these memoirs came to be fully recognised only very gradually, in many instances after important results had been obtained independently by later investigators. In 1892 Ostwald brought out a German translation which was reviewed at the time in these columns (vol. xlvi., p. 245). A French translation followed in 1899, and now at length we have these epoch-making papers reproduced so as to be accessible to everyone. In their new dress they cover about a third more pages than in their original form in the Transactions of the Connecticut Academy of Arts and Science, and the larger type and broader page impart a dignity worthy of their high position in the literature of thermodynamics.

The first volume closes with some unpublished fragments which were intended to form a supplement to the "Equilibrium of Heterogeneous Substances." Only two of a list of nine subjects are touched upon, and one cannot but have a feeling of deep regret that the distinguished author was unable to carry out his project.

The second volume contains twenty-one distinct papers and articles arranged under four headings. In a paper on the fundamental formulæ of dynamics, Gibbs suggests using δx, δy, δz instead of the usual δx, δy, δz, and shows that for certain problems the modification is of advantage. The second paper is a single page abstract from the Proceedings of the American Association for the Advancement of Science on the fundamental formula of statistical mechanics, and is of interest as showing the trend of his thinking sixteen years before the publication of his great work on the subject. Eight papers then follow on vector analysis and multiple algebra. The first of these is the reprint of the famous "not published" pamphlet which was printed for private circulation in 1881-4, and it is in reply to certain criticisms of this pamphlet that some of the succeeding papers were written, chiefly as letters to NATURE. Willard Gibbs received his first impulse towards the study of vector methods from Maxwell, who used the quaternion notation in his "Electricity and Magnetism." Not caring for the quaternion approach for reasons which are explained fully in his controversial articles, he elaborated a notation of his own for the frequently recurring functions familiar to students of Hamilton and Tait. What gives Gibbs's method its character is, however, his "dyadic" notation for the linear vector function. Unlike Hamilton's ϕ, which has, so to speak, only one hand to grip the operand which follows, Gibbs's dyadic has two hands, with one of which it may grip forward and with the other backward as occasion may offer. It cannot, however, grip with both at once, so that the double-handedness is only apparent. Moreover, it is only in its expanded form that the dyadic is able thus to clerk on to an operand on either side. When, as is frequently the case, the Hamiltonian function ϕ is used, the method becomes identical with that of quaternions.

A very readable paper is that on multiple algebra which Gibbs originally delivered as his presidential address before the mathematical section of the

American Association for the Advancement of Science. Here we find expounded with rare clearness and happy illustration the essential principles of multiple algebra. We can imagine many aspiring mathematicians getting from this article a strong impulse towards the study of a subject the fundamental principles of which are at times almost intuitive, but the working out of which in detail is full of difficulties and pitfalls to trap the unwary.

Under the heading of "The Electromagnetic Theory of Light" there are five papers, all important contributions. They show the sufficiency of the electromagnetic theory to explain dispersion and double refraction, whereas the elastic solid theory of Green could not be reconciled with experimental facts. The elastic theory was, mathematically speaking, rescued from its distressed condition by Kelvin when he imagined the contractile ether, and in regard to this Gibbs points out that, although it explains many phenomena as simply as the electromagnetic theory, it fails to give a satisfactory explanation of dispersion.

Finally, there are six miscellaneous papers, partly reviews and biographical notices. The closing sentence of his notice of Clausius, in which reference is made to the great number of papers published by the eminent German, might by a slight modification be applied to himself:—

"Such work as that of [Gibbs] is not measured by counting titles or pages. His true monument lies not on the shelves of libraries, but in the thoughts of men, and in the history of more than one science."

The papers have been edited with great care by Henry Andrews Bumstead and Ralph Gibbs van Name, and the former, in the biographical notice prefixed, discusses with knowledge the scientific work done by Willard Gibbs, and gives a clear-cut picture of the man himself. A portrait forms the frontispiece to vol. i.

C. G. K.

TECHNOLOGY OF SOAPS AND CANDLES.

Modern Soaps, Candles and Glycerin. By L. L. Lamborn. Pp. xx+688. (New York: D. Van Nostrand Company; London: Crosby Lockwood and Son, 1906.) Price 30s. net.

THIS is a work intended primarily for the soap manufacturer, and more especially for the American beginner in the art and craft of soap-making. The author finds, he tells us, that the industry has hitherto been indebted for its technical literature to those who can write, but have little worth telling. To remedy this state of things he, a practical man, to practical men sends forth the present volume.

On the whole the effort is a successful one, though the book has defects. Let us summarise these at the outset. Heavy both in style and in avoirdupois, and printed on glazed paper that is very trying to the eyesight, the work is by no means an attractive one to read. There is much tedious repetition, and an unnecessary amount of technical slang is employed. For example, on p. 340 we are directed to "kill the rosin as already described, but leave the soap open on salt alone, with entire absence of strength." The book is quite "practical" enough to dispense with kettle-room jargon. Generally, it suffers from excessive verbiage, the author has a tendency to write round his subject as well as upon it.

Now let us see what there is of value in the book. The various operations of soap manufacture are fully described, about two-thirds of the available space being devoted to this branch of the subject. Two introductory chapters outline the history and principles of soap making, then come three others, dealing respectively with the raw materials, their purification and their chemical characters; these are followed by one describing the mechanical equipment of a soap factory, and next by the sections which discourse of the various kinds of soap and the processes involved in their production. The treatment is eminently practical, and, so far as the reviewer can judge, entirely trustworthy. Many useful tables, formulæ, and recipes are embodied in the text, a good section on essential oils and soap perfumery is interpolated, and a large number of illustrations of apparatus are included. These last are naturally, figures of American machinery almost exclusively; they constitute quite a feature of the work.

In connection with "medicated" soaps, the author is sceptical about any appreciable curative effect being rightly attributable to the medicament or disinfectant incorporated with the soap. The proportion of active ingredient is often very small, and under ordinary conditions of use the time of contact with the skin is but short, so that the scepticism is probably justified. Such curative property as the soaps may possess is, the author thinks, inherent in the detergent itself; the remedial value lies in the mechanical action of cleansing rather than in any specific bactericidal or antiseptic effect of the incorporated substance.

In the section dealing with the manufacture of candles there are two points of special interest. One of these relates to a long-standing problem of chemical technology, namely, how best to utilise the by-product oleic acid as a source of candle material. This acid forms a large proportion of ordinary fats, but, being a liquid, is not suited for the production of candles. It is possible, however, to convert the oleic acid into solid substances (elaidic acid, hydroxystearic acid), which can be so used, but until recently the expense and the smallness of the yield have prevented the satisfactory utilisation of the by-product in this way. The author outlines the latest modification of the process for transforming oleic acid into hydroxystearic acid; it is asserted that from 85 per cent. to 95 per cent. of the former can now be obtained as the solid product, instead of only 30 per cent. as previously produced. Sulphostearic acid and stearolactone are obtained by dissolving the oleic acid in petroleum and treating the solution with strong sulphuric acid; the first gives hydroxystearic acid on hydrolysis with steam, the stearolactone is re-con-

verted into oleic acid and again subjected to the action of sulphuric acid. The author, unfortunately, says nothing definite about the vital matter of expense, but as far as the complete recovery of the by-product is concerned the process now leaves little to be desired.

The other matter of interest is the Twitchell method of decomposing fats into their constituent fatty acids and glycerin. This is effected by boiling the fat with water and a small quantity—about 1 per cent.—of sulphobenzenestearic acid. On standing, the products of the reaction separate into layers of fatty acids and glycerin of a relatively high degree of purity. Not only in candle-making, where it is now largely used, but in soap-making, the process is claimed to be economically superior in several respects to the time-honoured method of saponification with alkali hitherto universally adopted. It gives a greater yield of glycerin, the cost of recovering the glycerin is smaller owing to the much greater purity of the menstruum, there is economy in the cost of material, since soda-ash can be used instead of the more expensive caustic soda for converting the fatty acids into soap, and, finally, the necessary mechanical equipment is simpler. Whether or not with these advantages the Twitchell process will eventually supersede the historic alkali method of soap-making remains to be seen; the indications are that it may well do so. Meanwhile, the remarkable steatolytic action of the sulpho-aromatic fatty acids, on which the process depends, is worthy of note from the scientific point of view. One explanation of the ease with which fats are resolved into their constituents by these compounds assumes it to be due to the emulsifying power of the sulpho acids, but the matter requires further investigation.

The most approved methods for the recovery of glycerin are fully described, and the work closes with a chapter on the chemical examination of raw materials and factory products.

In view of recent events in this country, it is interesting to read that in the United States, where other kinds of "trusts" seem to flourish, there is but little "cooperative control of production" in the soap industry. On the contrary, there is a marked tendency towards self-sufficient independence among the individual producers. The author's reason for this is that, whilst control of the raw material and of the facilities for transport are two essential factors in organising a successful "combine," these conditions are largely absent in the production and distribution of soap.

"The chief raw material is obtainable wherever meat is eaten, and the market exists wherever cleanliness is appreciated."

Possibly more than anything else it was the difficulty of monopolising the supplies of raw material that recently enabled the individual producers in this country to maintain the "tendency towards self-sufficient independence" which the author notes in the case of soap-makers in the United States.

C. SIMMONDS.

SOME PROLEGOMENA TO THEOLOGY.

Völkerpsychologie: eine Untersuchung der Entwicklungsgesetze von Sprache, Mythus und Sitte. By Wilhelm Wundt. Zweiter Band. Mythus und Religion. Erster Teil. Pp. xi+617. (Leipzig: Wilhelm Engelmann, 1905.) Price 14s. net.

THIS is the first part of the second volume of Wundt's important work, and it deals in three long chapters with imagination, imagination in art, and imagination in the formation of myths.

The first chapter defines imagination, and points out its chief characteristics, *e.g.* that it is intuitive in its working, and does not deal with the products of the understanding, that it is creative, and that it is spontaneous or involuntary. The author claims that experimental analysis reveals its mode of operation as a subjective condition of all our perceptions in space and time. More especially the illusions in space-perceptions are discussed by which, *e.g.*, a tetrahedron as represented on paper may appear to face the spectator in two quite different ways according to the position of the point fixated, and again in regard to time it is pointed out how the imagination of itself supplies the measure into which a succession of musical notes of precisely the same emphasis and length is fitted, so too with speech-rhythm. Sensations of light, colour, movement, and the like are next discussed, and the author reaches the conclusion that there are two main principles at work in imagination, the one *vivifying apperception*—the spectator so projecting himself into the object that he feels himself at one with it, and the other *the power of illusion or imagination to heighten feeling*. The writer now passes to child-psychology, and analyses imagination in children as it may be observed in their play, their fairy tales, and their attempts at drawing, and in comparing the products of the artistic faculty in children and in savages he emphasises the two points that neither savages nor children, as a rule, copy objects before them, but recall what they have seen, and that both prefer objects in which they have an immediate interest, generally men and beasts.

The second chapter deals with imagination in art. Wundt believes that it is utterly idle to inquire what form of art arose first, that in the most primitive races we find the beginnings, not only of the musical arts (including both dance and song) but of the graphic arts as well. Into the details of the chapter, which discusses the whole range and development of the graphic and musical arts, we cannot now enter. The author inquires among other things why in early art beasts are drawn more truthfully than men, and notes that as early art is generally based on recollection it exhibits a face view of human beings but a profile view of beasts. The discussion of *Stilisierung* on pp. 186–8 is interesting, and the gradual progress exhibited of the alligator motive, though perhaps not convincing to the ordinary man, is as possible as many other things in anthropology.

A suggestive treatment, too, may be found of the different effects produced by portrait and statue (p 274), and of the reasons that may be given for the differing shapes of Egyptian and Greek temples In dealing with song, the author contests the view of Preuss that all work-songs were originally charm-songs He strongly opposes the theory of Jacob Grimm that the fairy-tale is a degenerate nature-myth, his own view with regard to the relative position of the fairy-tale, the nature-myth, and the epic appears to be that the epic has two sources, traditions of actual heroes on the one hand, and the despised fairy-tales on the other, and that it has not as its immediate preparation any such high-flown theogony and cosmogony as the supporters of the Grimm theory allege He discusses, too, the views of Usener, the foremost representative of the nature-myth hypothesis, who regards Thersites, for example, as being originally a god, and who sees in the struggle between Thersites and Achilles a variation of the old story of the struggle between summer and winter

The third and last chapter opens with a contrast between the historical and the psychological treatment of mythology, and the author claims that psychology is of more importance in dealing with myth than in dealing with speech, which after all is, in the narrower sense, a psychophysical function His discussion of the various types of theory the naturalistic, the animistic, the theory of analogy and the like, if full and adequate, is a little hard to follow The author is strongly opposed to the hypothesis that myths have all arisen in one period and one country

"If Anthropology has established anything," he writes, "it is this, that the qualities of human imagination and the feelings and emotions that influence the working of the imagination agree in their essential features in the men of all zones and countries, and that therefore no migration-hypothesis, going far beyond the bounds of possible proof, is needed to explain the similarity of certain fundamental ideas in mythology, while on the other hand the perpetual differences of these products of the imagination, depending as they do on natural surroundings, race and degree of civilisation, in many ways point directly to an autochthonous origin"

The cream of Wundt's own psychological theory on the matter seems contained in p 579, mythological personification he regards as only a heightened form of what writers on æsthetics call *Einfuhlung*, "a form in which the whole personality in its momentary condition of consciousness, together with the after effects of earlier experiences which enter into this, passes over to the object" So we have only to do with a modification of that general function without which the object could not exist for us at all, namely, apperception

Space fails us to discuss the topics of the closing pages, the distinction drawn between myth and poetry, the mutual influence of myth and poetry, their relations to speech, and so on The second part of this volume will be concerned with the problems that surround the connection between myth and religion. The full significance of Wundt's contribution to his present subject can hardly be realised until that part has appeared, and for this and many other reasons its speedy publication will be welcome to the numerous readers whom this instalment has doubtless interested and attracted.

COAL MINING

The Principles and Practice of Coal Mining By James Tonge Pp viii+363 Illustrated (London Macmillan and Co., Ltd, 1906) Price 5s net

UNTIL the year 1866, when Sir Warington Smyth wrote, for Weale's excellent series of rudimentary handbooks, his little book on coal-mining, the art of mining was in the trammels of empiricism, but since that date progress has been rapid Indeed, the tendency of the times is now towards a higher standard in mining as in all branches of technical education Greater efficiency is consequently now demanded of candidates for the Board of Education examination in the principles of mining, and for the examinations for certificates as colliery managers and under-managers In order to meet these conditions there has been of recent years a steady output of new elementary mining text-books Many of these are excellent, but not one of them is presented in so attractive a form as the latest addition to the list by Mr James Tonge Well printed, tastefully bound, and copiously illustrated, it gives in concise form an accurate view of the subject of coal-mining, together with such information regarding collateral science as is essential for the elementary student

In his treatment of the subject, the author wisely has followed closely the logical and natural order laid down by the late Sir Clement Le Neve Foster for the Board of Education syllabus General ideas are first given regarding the occurrence of coal and the methods of search The sinking of shafts and the working of coal then receive attention The means of supporting the roof and sides of underground excavations, and the conveyance of the coal to the shaft and thence to the surface, come next Other chapters are devoted to the important operations of keeping the workings free from water and of supplying them with fresh air and light The volume concludes with chapters on the preparation of coal for the market, and on the accidents and diseases incidental to the miner's calling, with some brief notes on the laws regulating mining in this country

These varied subjects are dealt with in a thoroughly practical manner, and although necessarily brief, the descriptions are well up to date We note, for example, an interesting account of the Parsons turbo-fan A screw fan, used in conjunction with a compound steam turbine, at a colliery at Wylam-on-Tyne exhausts air from the pit and discharges it into the atmosphere through a conical outlet The diameter of the fan is 5 feet, and it passes 120,000 cubic feet per minute at 2-inch water gauge, running at a speed

of 2000 revolutions per minute. The steam pressure at the turbine is 70lb per square inch, and the exhaust steam is condensed. At the Hulton Colliery Company's Deep Arley Pit, with which the author is connected, a turbine-driven fan has recently been erected. The plant consists of a screw propeller fan 9 feet 6 inches in diameter, driven direct by a steam turbine. The efficiency of the fan varies from 50 to 60 per cent., and although this is low compared with that claimed for other fans, the economy of the plant, or in other words the steam consumed per useful air horse-power output, compares favourably with that usually obtained with centrifugal fans driven by high-class reciprocating steam engines. An illustration of the plant is given. Throughout the book the illustrations are adequate, and in many cases very good, the only exception being Fig. 111, of a coil clip for endless rope haulage, which appears to be incorrectly drawn.

AMPHIPODOUS CRUSTACEA

Das Tierreich. 21 Lieferung. Crustacea Amphipoda, I., Gammaridea. By the Rev. T. R. R. Stebbing, F.R.S. Pp. xxxix+806, 127 figures in text. (Berlin: R. Friedländer und Sohn, 1906.) Price 48 marks.

READERS of Stevenson may possibly remember that when the hero of "Catriona" took leave of Alan Breck on Gillane Sands and turned to meet his pursuers his attention was caught, in the solitude and silence of that "unchancy" place, by "the sand-lice hopping nimbly about the stranded tangles." One might search far through the fields of literature before finding another mention of the amphipodous Crustacea. Their small size, the aquatic habits of the majority, and the fact that they are neither immediately useful nor directly harmful to man, combine to withdraw them from popular observation, while even to many who claim the title of naturalist they are known only by name. Yet the student who attempts to gain some knowledge of this group of animals is likely to be bewildered at the outset by the almost infinite variety of specific differentiation which they present, no less than by the overwhelming mass of technical literature in which their peculiarities are recorded.

It is true that more or less comprehensive systematic monographs and summaries of what might be called the "minor morphology" of the group are not wanting. In his "Catalogue of the Amphipodous Crustacea in the British Museum," published in 1862, Mr. C. Spence Bate attempted a revision of all the forms then known, and thereby lightened considerably the task of subsequent workers, if sometimes also adding not a little to their perplexities. Later monographs, such as those of Boeck, Bovallius, Sars and Mayer, have dealt only with single subdivisions of the order or with the Amphipoda of restricted geographical areas. In 1888, however, Mr. Stebbing's monumental report on the Amphipoda of the *Challenger* Expedition not only described a larger and more varied material than had been at the disposal of any previous writer, but gave an exhaustive and critical analysis of the earlier literature, the like of which is available for very few other groups of animals.

When, therefore, it was announced that Mr. Stebbing had undertaken to prepare a revision of the Amphipoda for the "Tierreich," every carcinologist anticipated that its publication would mark an epoch in our knowledge of the group. The present volume of more than eight hundred pages contains only the first part of this work, dealing with the Gammaridea, the largest of the three legions (or suborders) into which the order is divided. It is in every way worthy of Mr. Stebbing's high reputation. The whole field of existing literature has been explored with painstaking minuteness (extending to the collection and recording of typographical errors), and an unrivalled experience in dealing with this group of animals has been brought to bear on the task of interpreting and criticising the descriptions of previous authors.

As Mr. Stebbing explains in the preface, the work as originally planned included all species described up to the end of 1898, but publication was unavoidably delayed. A supplement has, however, been added which enumerates, without describing, the new species and genera established up to the end of 1905. Excluding those dealt with in the supplement, the number of species accepted as valid is 1076, while 257 others are mentioned as doubtful. They are distributed among 304 accepted and nine doubtful genera and forty-one families.

In a work like the present, questions of nomenclature inevitably come to the front, and even those zoologists who deprecate unnecessary interference with established names will admit it to be desirable that in an authoritative revision of a group of animals an effort should be made to settle the nomenclature on a stable basis. Mr. Stebbing has devoted much attention to this point, and his decisions will in most cases be accepted as final by the majority of students. We may regret, however, that he has not seen his way to mitigate the severity of his interpretation of the rule of priority in one or two cases where it seems to introduce, instead of removing, confusion. As Mr. Lydekker pointed out some time ago in a letter to NATURE (vol. lxxi., p. 608), the transference of old and well-known generic names to other genera may often be seriously misleading. With regard to one such change adopted in the present work, Canon Norman recently expressed the opinion that, "considering the inadequate description of the genus Podocerus and its erroneous use for nearly one hundred years, the name ought to be excluded from an altered use." This opinion, coming from one of so wide experience in systematic zoology, will find many supporters, at least among those who think that the animals themselves are more profitable objects of study than their names.

Mr. Stebbing's volume will remain the standard work of reference on the Gammaridea for a very long

time to come, and he has earned the gratitude of all students of the group by its publication. The editors of "Das Tierreich" are to be congratulated on the latest addition to the exceedingly useful series of monographs issued under their direction.

W. T. C.

OUR BOOK SHELF

Incubation, or the Cure of Disease in Pagan Temples and Christian Churches. By Mary Hamilton. Pp. 223. (London: W. C. Henderson and Son; Simpkin, Marshall, Hamilton, Kent and Co., 1906.) Price 5s. net.

"IN the ancient science of divination, four working methods were commonly practised. Revelations of the future were deduced from natural portents, from the flight of birds, from the entrails of sacrificial victims, or from dreams. Incubation was the method by which men sought to entice such dreams." These sentences from the introduction indicate the substance of this work. The book is divided into three parts:—(1) incubation in pagan temples, *e.g.* the cult of Asklepios at Epidauros, Rome, Athens, &c., and at the Oracles, Amphiaraios, and others; (2) incubation in Christian churches during the Middle Ages; and (3) the practice of incubation during modern times in Italy, Austria, Greece, and the Greek islands. Translations are given of the various stelæ which describe the cures wrought and the methods employed in procuring them. The book forms a useful summary of the subject, valuable both to archæologists and to historians of medicine.

Manual of Wireless Telegraphy. By A. F. Collins. Pp. x+232. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 6s. 6d. net.

THE present writer ventured to suggest, in an article in NATURE a short time ago, that with the publication of a really standard book on any particular branch of electricity the issue of further literature on the same subject should cease. If this recommendation had been adopted the present volume would never have seen the light. It does not profess to be anything more than a manual specially adapted for those who are, or desire to become, wireless telegraph operators. There are already numerous books covering almost identically the same ground, and we are of opinion that the useful information contained in any of them could be much more effectively learnt in an hour's practical instruction. Compared with other books of its kind, it may be pronounced a favourable specimen. The style, though a trifle too American for our taste, is simple, and the diagrams are numerous and clear. The illustrations are also plentiful and well reproduced. A list of stations and ships equipped on the various systems forms a distinct feature of the book which will probably remain up to date for a few weeks longer.

M. S.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. vi., Noctuidæ. Pp. xiv+532; pls. xcvi-cvii. (London: Printed by order of the Trustees, 1906.) Price 25s.

THE present volume is the third of those devoted to the great family Noctuidæ, and includes the subfamily Cucullianæ, with 111 genera and 693 species, a considerable number of both genera and species being described as new. In addition to the coloured plates there are 172 plain illustrations in the text, generally representing the body and left wings of a specimen, the right wings being denuded of scales to show the neuration. To the right of this again is the outline of the thoracic crest and head in profile, the latter showing an antenna, eye, palpus, &c. The first text figure, however, represents the larva of *Cucullia verbasci*. Opposite p. 2 is a large table, showing the relationship of the genera regarded as belonging to the Cuculllanæ with one another. The general arrangement and character of this volume differ little from those which have preceded it. Full tables are given of genera and species, and the descriptions are quite sufficiently long for most practical purposes. Brief notices of larvæ and food plants are added, when known.

It is very creditable to all concerned that this important work should be carried on so steadily, a volume appearing about every two years. It may be interesting to notice the dates of the prefaces of each of the six volumes already published:—Vol. i. (Syntomidæ), September 30, 1898; vol. ii. (Arctiadæ: Nolinæ, Lithosianæ), January 20, 1900; vol. iii. (Arctiadæ: Arctianæ, and Agaristidæ), June 20, 1901; vol. iv. (Noctuidæ: Agrotinæ), June 20, 1903; vol. v. (Noctuidæ: Hadeninæ), February 24, 1905; vol. vi. (Noctuidæ: Cuculllanæ), November 1, 1906.

Die meteorologischen Elemente und ihre Beobachtung mit Ausblicken auf Witterungskunde und Klimalehre. By Otto Meissner. Pp. vi+94; with 33 illustrations. (Leipzig u. Berlin: B. G. Teubner.)

THIS very useful text-book, intended for higher schools and for self-instruction, forms part vi., vol. ii., of the collection of scientific treatises published by O. Schmeil and W. B. Schmidt. It explains the physical laws necessary for clearly understanding meteorological processes and apparatus, and contains valuable footnotes, together with the derivation of all technical terms employed in the text. Many points, such as the difference between periodical and non-periodical oscillations of meteorological elements, "variability" of temperature, the use of the cloud-mirror, &c., which are frequently puzzling to observers, and are generally only dealt with in treatises of greater pretensions, are made quite clear by means of examples. We recommend the perusal of the work to any meteorological students who are acquainted with the German language.

The Treatment of Diseases of the Digestive System. By Prof. Robert Saundby. Pp. viii+133. (London: Charles Griffin and Co., Ltd., 1906.) Price, 3s. net.

THIS unpretentious little book will serve to bring before the practitioner the salient points in the diagnosis and treatment of diseases of the digestive tract. The dose of bismuth in many cases might be larger; useful drugs such as salol, bismuth salicylate, and ipecacuanha are not mentioned, and no precautions are detailed in the use of thymol in ankylostomiasis. Otherwise the teaching throughout seems to be sound and commonsense.

The Plants of New South Wales. By W. A. Dixon. Pp. xxxiv+322. (Sydney: Angus and Robertson, 1906.) Price 6s. net.

THIS is a handy little book providing a compact guide for naming flowers in the field by means of analytical tables on similar lines to Gremli's well-known flora of Switzerland, but localities are omitted. The author lays stress on the extensive use made of vegetative characters for identification, with which there can only be entire agreement so long as the characters are determinative.

While a condensed guide of this kind is of the greatest service, for carrying about, sooner or later the botanist is sure to require a flora giving fuller

descriptions The author has prepared for this contingency by providing references under each genus to the "Flora Australiensis" and the "Flora of New South Wales," and has arranged his system and nomenclature according to the last named Ferns and fern allies are included, but of monocotyledons the families of rushes, sedges, and grasses are left out

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications]*

Magnetic Storm and Aurora on February 9-10

A MAGNETIC storm was recorded at the Kew Observatory (National Physical Laboratory) on the afternoon of February 9 and early morning of February 10 larger than any that has occurred since October 31, 1903 The curves were slightly disturbed during the whole of February 9, but the storm may be regarded as commencing with a rapid movement of a few minutes of arc in the declination needle at 2 15 p m, with a synchronous sudden rise of 45 γ (1 γ=0 00001 C G S) in the horizontal force The storm lasted an unusually short time, being practically over by 3 a m on February 10, but several large rapid movements were recorded The largest declination movement occurred between 8 19 p m and 8 45 p m on February 9 During these twenty-six minutes the needle moved 57′ to the west and then 73′ to the east, the extreme westerly position being reached at 8 34 p m The most easterly position during the storm was reached at about 10 55 p m, when the trace was off the sheet for a few minutes The range during the storm actually shown on the sheet was 1° 38′ Between 1 13 a m and 1 45 a m on February 10 the needle moved steadily, without sensible oscillation, to the west, this movement reaching 1° The rate of movement was practically uniform from 1 13 a m to 1 33 a m, when it accelerated so suddenly that the curve resembles two straight lines inclined at a finite angle

In the case of the horizontal force, the force fell more than 355 γ between 8 25 p m and 8 33 p m on February 9 when it went off the sheet for a few minutes Between 8 40 p m and 8 49 p m it increased fully 240 γ The total range during the storm exceeded 480 γ

The vertical force, though less disturbed than the other elements, showed a range of 325 γ, the highest and lowest values being attained at 6 25 p m on February 9 and 1 48 a m on February 10 respectively The most rapid change took place between 8 25 p m and 8 42 p m on February 9 The storm was doubtless associated with the aurora, which seems to have been widely observed on the evening of February 9 CHARLES CHREE

AN unusually beautiful display of aurora borealis was seen here (51° 56′ N lat, 2° 35′ W long) between 6 30 p m and 11 p m on Saturday evening, February 9 At about 6 30 p m I became aware that the north-western sky, instead of darkening after sunset, was becoming lighter and the quivering upward rays showed that it was the northern lights The aurora was at its best between 8 p m and 9 30 p m, stretching half across the northern heavens from Cetus to Leo, from the horizon upwards towards the zenith, some of the curved flashes reaching to Jupiter

This aurora was characterised by the brilliant soft whiteness of its light, occasionally tinged with pale green which filled the north-western and northern sky from the horizon to a considerable elevation, from which at times long rays shot up, but more generally the lights appeared as curved, wavy bands rushing up to the zenith, and hanging there for a few seconds as white, cloudy patches in the clear sky among the brighter stars Between 8 45 p m and 9 15 p m the colour about Ursa Major and Leo was a dull, faint red The aurora was not watched after 11 o'clock, but by that time it had greatly diminished in brilliancy, and the sky was becoming cloudy

I may add that for some weeks I have been noting the sun-spots, of which lately there have been a considerable number, and on the morning of February 9 one near the middle of the sun's disc was so large that I afterwards saw it with the naked eye through smoked glass

T A

Dadnor, near Ross, Herefordshire, February 11

The Flight of an Elongated Shot

WOULD any reader of NATURE kindly enlighten me on the following points in the theory of projectiles?

(1) Whether one is right in supposing that a bullet or shot of the modern pointed cylindrical form, when fired at any angle of elevation *in vacuo*, would preserve the original direction of its axis of rotation so that at the end of its flight its long axis would be considerably inclined to its line of flight

(2) Whether a similar shot fired through the air would be acted upon by a couple tending to produce rotation about an axis perpendicular to the plane of the trajectory, the magnitude and direction of this couple depending upon the form of the projectile and the position of its centre of gravity, a zero value being possible and whether the effect of this couple would be to produce rotation about an axis in the plane of the trajectory and perpendicular to the long axis of the shot so that the point of the projectile would be deflected downwards and to the right or left

(3) Whether if the above suppositions are correct any successful attempts have been made to keep the long axis of the shot tangential to its trajectory during the whole course of its flight by giving it a particular form, and varying the density of its parts in a particular way

P D STRACHAN

Philippolis, Orange River Colony

THE answer to proposition (1) is best given for the most general case A body projected in any manner in a field of gravity *in vacuo* will move so that the centre of gravity (C G) describes a parabola while the body moves about the C G so that to an observer seated at the C G the body has the motion described by Poinsot in which the momental ellipsoid rolls on a fixed plane The normal to this plane is the axis of resultant angular momentum and this axis preserves a direction fixed in space while the body moves about it When this axis coincides with a principal axis the body appears to be spinning steadily about the axis but a closer observation reveals always a precessional and nutational motion

The question in the limited form of proposition (1) presupposes a body of perfect uniaxial symmetry spun accurately about its axis but such a condition cannot be realised in practice any more than it is possible to balance a pin on its point and so it is better to replace this ideal state of proposition (1) by the penultimate state in which the spinning body like a sleeping top upright has steadiness almost perfect

With this limitation the axis of an elongated shot would move parallel to itself on the whole if fired in a vacuum as stated in proposition (1) But if fired in air as in proposition (2) a couple arises as soon as the axis is oblique to the direction of motion tending to place the axis of an elongated shot broadside to its motion and at right angles to the tangent of the trajectory and this couple acting on the rotating shot will cause the axis to precess about the tangent Even in the absence of air resistance and gravity the resulting motion is of great complexity where the body is influenced by the stirring up of the surrounding medium and the special case of a figure of revolution discussed by Kirchhoff and Clebsch is more complicated than the gyroscopic motion of a top spinning in a smooth cup

The problem defies analysis when gravity and air resistance are taken into account all we can say is that the frictional drag damps the nutation and causes the axis of the shot to follow the tangent of the trajectory very closely the point of the shot being seen to be slightly above the tangent and to the right with a right handed spin The conditions of proposition (3) are secured then

independently of any supposition or condition of shape and density of the shot, provided the spin imparted by the rifling is suitable, and that the trajectory is not curved too much A G GREENHILL

The Atomic Weight of Nickel

In a paper on the absorption of Röntgen rays (*Journal de Physique*, p 653, 1901) M Benoist shows the connection between the transparency to X-rays of elementary substances and the atomic weight of those substances by means of a curve, which in general exhibits a fall of transparency with a rise in the atomic weight of the absorbing substance In continuing investigations on secondary X-rays, Mr C A Sadler and I have found that by replacing Benoist's primary beam by secondary beams from different substances, curves are obtained similar to that got by using a beam direct from an X-ray tube, except in the region of atomic weights near to that of the radiator In those regions a strongly marked deviation occurs, showing a special transparency to the secondary radiation from a substance, by a sheet of the same substance, and a less strongly marked abnormal transparency of those substances with atomic weights differing little from that of the radiator Also the nearer on the same side the atomic weight of the absorbing substance is to that of the radiator, the greater is the deviation from the normal transparency This effect does not indicate that the secondary rays as emitted by the atoms of a substance are specially penetrating, but simply that in emerging from the interior atoms to the surface a selective absorption has occurred, leaving the remainder specially penetrating to further layers of the same substance and to a less extent to substances of neighbouring atomic weights This is not a property of secondary rays alone, for experiments on primary beams which have passed through thin sheets of metal show the same effect

In making such experiments on a number of metals it was found that the radiation from nickel was much more abnormally penetrating to copper than to iron, indicating a proximity of atomic weight to that of copper On the other hand, when cobalt was used as a radiator the rays were much more abnormally penetrating to iron than to copper, indicating that the atomic weight of cobalt is nearer that of iron than of copper

The two experiments together furnish what seems to us to be the strongest evidence, based, not only on empirical law but on theory, that the atomic weight of nickel is not slightly less than that of cobalt (the accepted values are Ni 58 7, Cr 59), but is considerably greater

The evidence however, does not end here In a paper on secondary Rontgen radiation I suggested a method of determining atomic weights—based on the fact that the radiation is purely an atomic property—by graphically plotting the absorbability of the secondary radiation proceeding from different elements subject to X rays and the atomic weight of the radiator A periodic curve was obtained in many portions of which the slope was so great that atomic weights might be obtained by interpolation with considerable accuracy

Using a thin plate of aluminium as the absorber, the relation between the absorbability of the radiation and the atomic weight of the radiator was found to be approximately a linear one for a long range of atomic weights on both sides of nickel Nickel itself, however, can only be brought into line by assigning it an atomic weight a little above 61 Many absorbing substances have been used and all give approximately the same value the maximum variation in the values found from these different experiments being about 0 3

The experiments on fairly good commercial specimens indicated an atomic weight of about 61 4 To make the evidence more conclusive and the numerical values as accurate as possible—though a 2 per cent or 3 per cent impurity could not materially affect the result—the purest specimens were used, and the atomic weight found by two separate series of observations did not differ by more than about 0 1 from the value previously obtained We are thus forced to the conclusion that the atomic weight of nickel is about 61 3 Details of these experiments we hope to publish shortly CHARLES G BARKLA

University of Liverpool February 6

ON HOMER LANE'S PROBLEM OF A SPHERICAL GASEOUS NEBULA

§ 1 A HIGHLY interesting problem of pure mathematics was brought before the world in the *American Journal of Science*, July, 1870, by the late Mr Homer Lane, who, as we are told by Mr T J J See,[1] was for many years connected with the U S Coast and Geodetic Survey at Washington Lane's problem is the convective equilibrium, of density, of pressure, and of temperature, in a rotationless spherical mass of gaseous fluid,[2] hot in its central parts, and left to itself in waveless quiescent ether

§ 2 For the full discussion of this problem we must, according to the evolutionary philosophy of the physics of dead matter, try to solve it for all past and future time But we may first, after the manner of Fourier, consider the gaseous globe as being at any time given with any arbitrarily assumed distribution of temperature, subject only to the condition that it is uniform throughout every spherical surface concentric with the boundary And our subject might be the absolutely determinate problem of finding the density and pressure at every point necessary for dynamical equilibrium But for stability of this equilibrium, Homer Lane assumed, rightly as I believe is now generally admitted, that it must be of the kind which two years later[3] I called convective equilibrium

§ 3 If the fluid globe were given with any arbitrary distribution of temperature, for example uniform temperature throughout, the cooling, and consequent augmentation of density of the fluid at its boundary, by radiation into space, would immediately give rise to an instability according to which some parts of the outermost portions of the globe would sink, and upward currents would consequently be developed in other portions In any real fluid, whether gaseous or liquid, or liquid with an atmosphere of vapour around it this kind of automatic stirring would tend to go on until a condition of approximate equilibrium is reached, in which any portion of the fluid descending or ascending would by the thermodynamic action involved in change of pressure, always take the temperature corresponding to its level, that is to say, its distance from the centre of the globe

§ 4 The condition thus reached, when heat is continually being radiated away from the spherical boundary is not perfect equilibrium It is only an approximation to equilibrium, in which the temperature and density are each approximately uniform at any one distance from the centre and vary slowly with time, the variable irregular convective currents being insufficient to cause any considerable deviation of the surfaces of equal density and temperature from sphericity

§ 5 A very interesting and important theorem was given by Prof Perry on p 252 of NATURE for July, 1899 according to which, for cosmical purposes, it is convenient to divide gases into two species—species P gases for which the ratio (k) of thermal capacity, pressure constant to thermal capacity volume con-

[1] 'Researches on the Physical Constitution of the Heavenly Bodies" *Astr Nachr*, November, 1905)

[2] By a gaseous fluid I here mean what is commonly called a "perfect gas" that is a gas which fulfils two laws —(1) Boyle's law At constant temperature it exerts pressure exactly in proportion to its density, or in inverse proportion to the volume of a given homogeneous mass of it. (2) A given mass of it kept at constant pressure has its volume exactly proportional to its temperature, according to the absolute thermodynamic definition of temperature (Preston's "Theory of Heat," Article 290) According to the "Kinetic Theory of Gases, every gas or vapour approximates more and more closely to the fulfilment of these two laws, the smaller is the proportion of the sum of times in collision to the sum of times of moving approximately in straight lines between collisions

[3] 'On the Convective Equilibrium of Temperature in the Atmosphere" (Literary and Philosophical Society of Manchester, January 21, 1862, re published as Appendix E, Math and Phys Papers, vol iii)

stant, is greater than $1\frac{1}{4}$, species Q, gases for which k is less than $1\frac{1}{4}$. On looking at the page of NATURE referred to, it will be seen that Perry questioned or even denied the possibility of a gas of species Q. His theorem is:—*A finite spherical globe of gas, given in equilibrium with any arbitrary distribution of temperature having isothermal surfaces spherical, has less heat if the gas is of species P, and more heat if of species Q, than the thermal equivalent of the work which would be done by the mutual gravitational attraction between all its parts, in ideal shrinkage from an infinitely rare distribution of the whole mass to the given condition of density.*

§ 6. From this we see that if a globe of gas Q is given in a state of convective equilibrium, with the requisite heat given to it, no matter how, and left to itself in waveless quiescent ether, it would, through gradual loss of heat, immediately cease to be in equilibrium, and would begin to fall inwards towards its centre, until in the central regions it becomes so dense that it ceases to obey Boyle's law, that is to say, ceases to be a gas. Then, notwithstanding Perry's theorem, it can come to approximate convective equilibrium as a cooling liquid globe surrounded by an atmosphere of its own vapour.

§ 7. But if, after being given as in § 6, heat be properly and sufficiently supplied to the globe of Q-gas at its boundary, and the interior be kept stirred by artificial stirrers, the whole gaseous mass can be brought into the condition of convective equilibrium.

§ 8. In the course of the communication to the Royal Society of Edinburgh, curves were shown representing the distributions of density and temperature in convective equilibrium for four different gases, corresponding to the four values of k:—

Gas (1) $k=1\frac{2}{3}$ (approximately the value of k for the monatomic gases, mercury vapour according to Kundt and Warburg, argon, helium, neon, krypton, and xenon).

Gas (2) $k=1\frac{2}{5}$ (approximately the value of k for seven known diatomic gases, hydrogen, nitrogen, oxygen, carbon monoxide, nitric oxide, hydrochloric acid, hydrogen bromide).

Gas (3) $k=1\frac{1}{3}$ (approximately the value of k for water vapour, chlorine, marsh gas, bromine iodide, chlorine iodide).

Gas (4) $k=1\frac{1}{4}$ (approximately the value of k for sulphur dioxide).

Four of these curves agree practically with curves given by Homer Lane for $k=1\frac{2}{3}$ and $k=1\frac{2}{5}$, in his original paper to the *American Journal of Science*, July, 1870.

§ 9. In a communication to the Edinburgh Royal Society of February, 1887, "On the Equilibrium of a Gas under its own Gravitation only," I indicated a graphical treatment of Lane's problem by successive quadratures, which facilitated the accurate calculation of numerical results, and was worked out fully for the case $k=1\frac{2}{5}$ by Mr. Magnus Maclean, with results shown in a table on p. 117 of the Proceedings of the Royal Society of Edinburgh, vol. xiv., and on p. 292 of the *Phil. Mag.*, March, 1887. The numbers in that table expressing temperature and density are represented by two of the curves now laid before the society. The other curves represent numerical results calculated by Mr. George Green, according to a greatly improved process which he has found, giving the result by step by step calculation without the aid of graphical constructions.

The mathematical interpretation of the solution for Perry's critical case of $k=1\frac{1}{5}$, and for gases of the Q-species, is exceedingly interesting.

The communication included also fully worked out examples of the general solution of Lane's problem for gases of class P of different total quantities and of different specific densities.

§ 10. In my communication to the Royal Society of Edinburgh, of February, 1887, I pointed out that Homer Lane's problem gives no approximation to the present condition of the sun, because of his great average density (1.4). This was emphasised by Prof. Perry in the seventh paragraph, headed "Gaseous Stars," of his letter to Sir Norman Lockyer on "The Life of a Star" (NATURE, July 13, 1899), which contains the following sentence:—

"It seems to me that speculation on this basis of perfectly gaseous stuff ought to cease when the density of the gas at the centre of the star approaches 0.1 or one-tenth of the density of ordinary water in the laboratory."

KELVIN.

THE PROBLEM OF THE RHODESIAN RUINS.[1]

THE recent investigation of some of the famous ruins of Rhodesia, conducted in 1905 by Dr. D. Randall-MacIver on behalf of the British Association and the Rhodes trustees, has resulted in an entirely fresh view of their origin and age. The hitherto generally accepted view, that these buildings were erected in very ancient days by a Semitic people, whose search for gold led them thus far afield, has received a serious check. Dr. MacIver's researches, conducted upon the lines of archæological investigation, point to the buildings in question being of comparatively recent date, not earlier, in fact, than late mediæval times. This result is the more striking when we remember that his previous researches have been mainly archæological, conducted chiefly in Egypt, and that, in consequence, we might expect a certain degree of bias in favour of retaining the ruins within the sphere of archæology. That a trained archæologist has been unable to find evidence of high antiquity upon the sites investigated is at least a strong point in favour of his argument.

Dr. MacIver made excavations on seven sites in various parts of Rhodesia, these being:—(1) Inyanga, on the Cecil Rhodes estate, sixty miles north of Umtali, (2) the Niekerk ruins to the north-west of Inyanga, (3) a site three miles south of Umtali; (4) Dhlo Dhlo, in the Incisa district, (5) Nanatali, sixteen miles east of Dhlo Dhlo, (6) Kami, fourteen miles west of Bulawayo, and (7) Great Zimbabwe, in the Victoria district, the site which hitherto had received the greatest attention. These sites were well selected as being distributed over a wide area, and, moreover, as differing considerably from one another both in general character and in special features, as also in the greater or less degree of elaborateness in their structure. It may be remarked at once that the distinctive features observable in comparing the different buildings are often no less remarkable than are the points of similarity. No two seem to be alike, and the divergences and specialisation render their individuality very striking.

The principal questions to be determined in regard to these remarkable buildings were: By what people and at what period were they erected? The controversy, which is still active, centres mainly upon these two main points, and the older theory of their Semitic origin and great antiquity, urged by Mauch, Bent, Keane, Hall, and others, is being maintained steadfastly and strenuously by several authorities. Dr. MacIver in the title of his book, "Mediæval Rhodesia," has hoisted his fighting flag. His conten-

[1] "Mediæval Rhodesia." By Dr. David Randall-MacIver. Pp. xv+106. (London: Macmillan and Co., Ltd., 1906.) Price 20s. net.

tion is that none of these buildings are referable to an earlier period than mediæval or post-mediæval times. He argues that none of the objects hitherto discovered in excavating within the area of the ruins would be recognised by an archæologist as "more than a few centuries old, and that the objects when not immediately recognisable as mediæval imports, are of characteristically African type." Inyanga and the Niekerk ruins do not appear to have produced any but native African objects, and at Umtali a fragment of glazed stoneware was the only foreign object found. At the better-known sites, Dhlo Dhlo, Kami, Nanatali, and Zimbabwe, a fair number of imported objects have been found; but here again Dr MacIver holds that in no case is there evidence of a pre-mediæval antiquity. As far as possible, he endeavoured in his excavations to reach the lowest strata, and to explore the levels which must be contemporary with the earliest portions of the walls of the buildings, and the objects found therein were naturally considered by him of the highest importance.

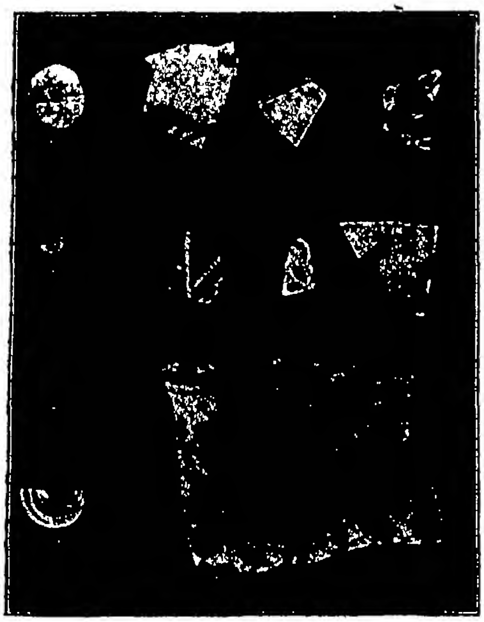


FIG. 1.—China and Ivory and Shell Beads found at Dhlo Dhlo. From "Mediæval Rhodesia."

It was at Dhlo Dhlo that he discovered his most valuable piece of evidence. The absence of objects of foreign workmanship and of known date at the Inyanga, Niekerk, and Umtali sites rendered impossible the assignment of any definite period to the buildings there, although the negative evidence may be held to indicate the lack of foreign influence, which itself may possibly be regarded as pointing to these sites being earlier than the others which were examined, a view which is held by the author on structural grounds. At Dhlo Dhlo, on the other hand, numerous imported objects were found, and in excavating one of the platforms upon which a dwelling had been erected, and which Dr MacIver asserts most positively is contemporaneous with the earliest portion of the building, he came across a piece of blue and white Nankin china in the unbroken cement floor of the dwelling. This fragment is shown (No. 20) in the illustration reproduced. If this cement floor was, as he maintains, erected at the same time as the oldest walls of the main building, we must certainly admit the validity of his contention that the building cannot antedate the fragment of porcelain, and that the date of erection, therefore, cannot be pushed back beyond late mediæval times. His critics appear willing to admit the validity of his argument as regards Dhlo Dhlo, but they urge that the buildings on this site are relatively late, and that this dating will not hold good in the case of the buildings at Great Zimbabwe, which they regard as much earlier.

Dr MacIver regards the principal buildings, such as the so-called "Elliptical Temple" at Zimbabwe, as being fortress-kraals, and urges that the "Elliptical Temple" itself was the fortified residence of the Great Chief, or Monomotapa, whose sway extended over an enormous area and a very extensive population. To understand how architectural feats, such as the finer Rhodesian buildings at Dhlo Dhlo, Nanatali and Zimbabwe, can have been achieved by the precursors of the modern South African natives, it is necessary to assume that in those days there was organisation of a far higher character than has obtained in recent years, organisation under great chiefs whose power and intelligence were of a relatively high order. This would appear, from the Portuguese and other records, to have been the case in the days of the Monomotapan empire of the Middle Ages down to the close of the sixteenth century. The Monomotapa, or paramount chief, may well have resided at Zimbabwe, and he is recorded to have had captains in various fortresses elsewhere. The organisation of labour implied by the elaborate and decorated stone architecture is certainly remarkable, more particularly when we compare these edifices with the results of the constructional efforts of the modern Kafir peoples, but under an intelligent and powerful ruler, and under stable conditions of life, a degree of culture may have been reached far higher than it is possible for smaller communities under lesser chiefs to maintain. It seems well within the bounds of probability that under such conditions even the finer buildings may have been erected by the more progressive and united precursors of the present native inhabitants of Rhodesia.

Even more remarkable in some respects, than the huge "fortified kraals" are the terrace walls on the Niekerk site described by Dr MacIver. These stone-built walls form irregular concentric rings round the hills upon which the villages were situated, and although structurally simple, cover an enormous area extending in close formation over a space of upwards of fifty square miles. They do not appear to have been erected as supporting walls for agricultural terraces nor to have been connected with an irrigation system, and, in the absence of evidence to the contrary, one must assume that their purpose was defence, though one accepts this view somewhat reluctantly, for, when regarded as an elaborate system of defensive girdle walls, one cannot but admit that their practical value is hardly commensurate with the enormous labour expended upon them. They recall to one's mind the *sementera* walls of Luzon, in the Philippines, which also form long, irregular, though concentric alignments up the slopes of the hills, following their contours, covering, too, a very large extent of country. In the case of the *sementeras* there are transverse walls dividing up the terraces into sections. They are purely for agricultural purposes, and are mostly, though not all, connected with a wonderful system of irrigation. It might be of use to compare the *sementera* system with the Niekerk terrace walls, on the chance of a clue to the

latter being found, and it is to be hoped that an accurate survey may eventually be made. The scientific study of the ruins is still in its infancy, and a vast amount of work remains to be done. As has been said, there are two distinct and antagonistic theories of their origin. It is eminently to be desired that the Rhodesian authorities will in every way encourage, nay, promote, further detailed excavations by trained men of science. Such a work would redound greatly to the credit of Rhodesia, and would be followed with the greatest interest throughout the scientific world. It would imply the exploitation of

It has been urged that the ruins have been shorn by Dr. MacIver of their romance. Taking the term romance in its strict sense, this may be true. For legendary uncertainty he has sought to substitute scientific fact. For ill-defined Semitic invaders he offers a native indigenous people, and King Solomon and the Queen of Sheba he replaces with the Monomotapa. How far he is justified will be shown by future investigations. At least he has presented his case in a straightforward and lucid manner in a very attractive and well-illustrated book, and it does not appear that the problem is in any way less fascinating

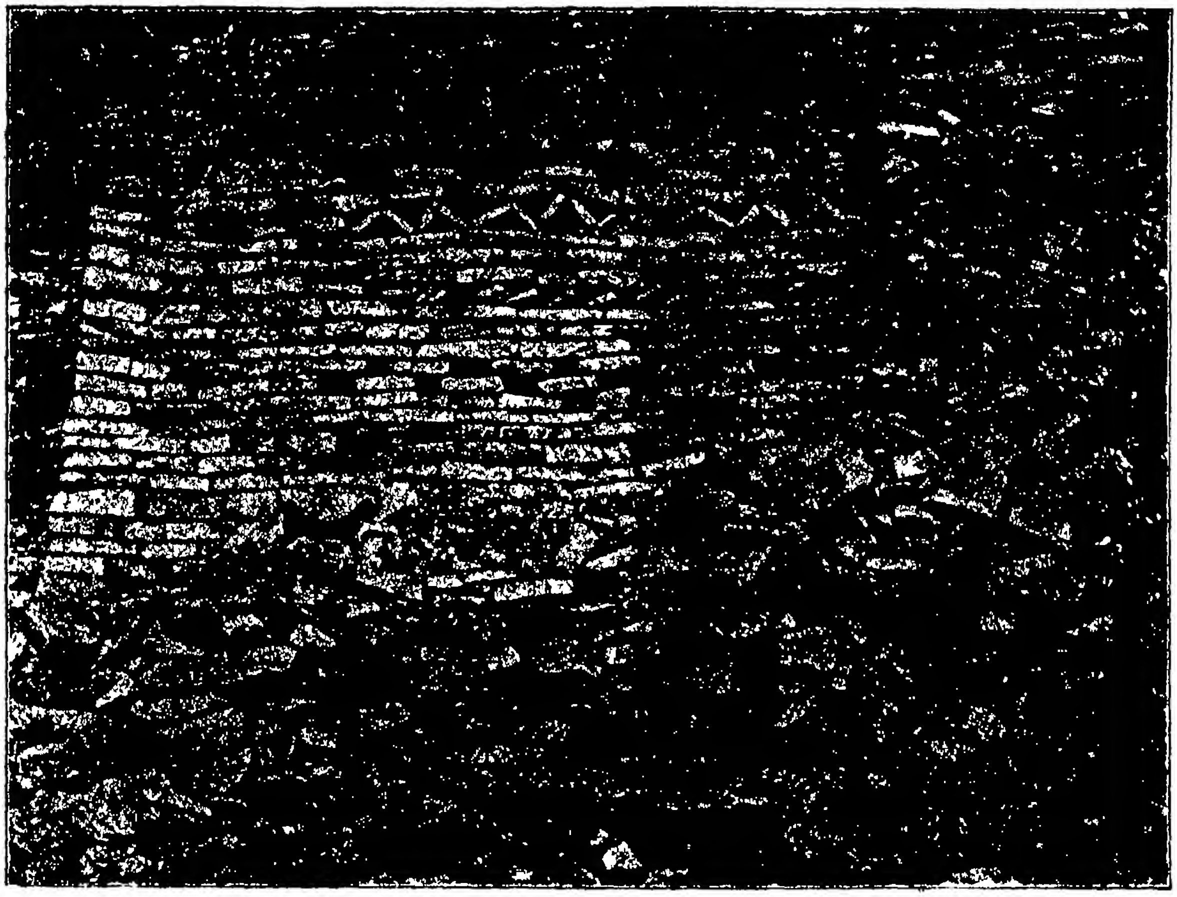


FIG. 2.—Decoration of West Side of Main Entrance, Dhlo Dhlo. From "Mediaeval Rhodesia."

one of the most valuable scientific assets of the country. Dr. MacIver makes out a strong case, but it is desirable to know more precisely to what group of Bantu peoples the buildings are assignable. Whence came they? Many of the native objects found are identical with those in use by the modern Kafir peoples, others, on the other hand, show affinities with a north-western culture and appear almost out of place where found. Then again, the older gold mines themselves have hardly been examined at all in detail. They should yield material of importance. It is further desirable to explain more fully the individuality of the different settlements and of the arts of their former inhabitants; to diagnose, for instance, the presence of very numerous stone carvings at the Umtali ruin, excavated by Captain E. M. Andrews, in the light of their prevailing absence elsewhere.

or less worthy of accurate study for having, perhaps, been transferred from the province of archæology to that of ethnology.

PROF. D. I. MENDELÉEFF.

DEATH has been very busy of late among the army of men of science, and nowhere has he been more active than in Russia, where within the space of a few weeks three of that country's foremost chemical philosophers—Beilstein, Mendeléeff, and Menschutkin—all men of front rank and of a world-wide reputation, have submitted themselves to the strict arrest of the fell sergeant. An occurrence of like character and extent is almost unknown in the annals of science. The nearest approach to it is in our own history, when within an interval hardly greater we lost Wollaston, Young, and Davy.

To Beilstein's life and services to chemical science we have already made reference, of Menschutkin, whose death has only just been announced, we hope to speak later. Our immediate concern is with the most distinguished of the eminent triumvirate—Dmitri Ivanovitsch Mendeléeff. The chief facts of Mendeléeff's personal history have been given in No. xxvi. of the series of "Scientific Worthies," which appeared in these columns so far back as 1889. It is sufficient here to recall that he was a Siberian, born at Tobolsk on February 7th (N.S.), 1834. He died, therefore, within a week of his seventy-third birthday. He was the seventeenth and youngest child of Ivan Paolowitsh Mendeléeff, Director of the Gymnasium at Tobolsk, who, shortly after the birth of his son Dmitri, became blind and lost his position. The family thereby became practically dependent upon the mother, Maria Dmitrievna Mendeleeva, a woman of great energy and force of character, who established a glass works in the town, on the profits of which she brought up and educated her large family. The story of Mendeléeff's youth and early struggles is given in the preface to his great work "On Solutions," which he dedicated to his mother's memory in a passage of singular beauty and power. At the age of sixteen he was sent to St. Petersburg, but, owing to official restrictions, he was prevented from studying chemistry under Zinin at the University, as he had intended, and was transferred to the Pedagogical Institute, where he came under the influence of Woskresenky in chemistry, and of Lenz in physics. Whilst at the institute he wrote his first paper on "Isomorphism," and after serving in the Gymnasium at Simferopol and at Odessa, he gained his *Magister Chemiae* in 1856, and was made a *privat-docent* in the University of St. Petersburg.

At about this period he was attracted to the special line of inquiry and of speculation which was the dominant and most striking feature of his scientific activity, and which eventually culminated in the great generalisation with which his name is inseparably connected. It is easy to detect in these early attempts at tracing the relations between the physical and chemical properties of substances and their molecular and atomic weights the germs of the conception which eventually took shape as the Periodic Law. His work on specific volumes was begun in 1855, and was continued by him in Heidelberg, where he went in 1859, and where he remained until 1861. Germany would appear to have exercised no permanent influence on Mendeleeff. He worked alone and seems to have derived nothing from personal contact with Bunsen and Kopp. It is significant of his perspicacity that he should at this time have clearly appreciated and publicly declared his belief in the value of Gerhardt's work on the determination of the chemical molecule—at the very period, in fact, when the whole weight of German authority was directed against the doctrine of the new French school. Returning to St. Petersburg, he became professor of chemistry at the Technological Institute. In 1866 he was transferred to the University, and in 1890 he was appointed head of the Standards Department.

Mendeléeff signalised his connection with the University by the publication of his "Principles of Chemistry," which has passed through many editions in Russia, and has been translated into German and English. It is not easy to avoid speaking of this work in terms which savour of hyperbole. Most treatises on chemistry owe a great deal to their predecessors. Indeed there is probably no form of literature which so obviously proceeds on strictly evolutionary principles. But Mendeléeff's great work is a thing apart—something *sui generis*. The bare facts of chemistry, in greater or less detail, are common to all such works, but most of them, we fear, would be classed by Lamb among the books which are no books. It is not so with Mendeléeff's "Principles." In its insight, in its grasp of detail and of principle, in its extraordinary power of coordination, in its suggestiveness, and in its wealth of speculation, it is a book among books, and may be read with profit and a pleasure occasionally tinctured with amusement by every true student, no matter how old. To those who had the good fortune to know its author personally it reflects the man in every page. Even the footnotes are instinct with character and originality. Mendeléeff's "Principles" may be said to stand in the same relation to the chemistry of the latter half of the nineteenth century that Dalton's "New System" did to the chemistry of the earlier half. Each work was the definite and orderly presentation of the doctrine and philosophy of its author.

There is hardly a department of chemistry in which Mendeléeff did not labour, at one time or other, during the thirty years of his activity as a teacher. Chemical mineralogy, chemical geology, and the chemistry of aliphatic substances in turn, and apparently with equal zeal, attracted his attention. It is to this catholicity and power of taking broad and comprehensive views of the operations of chemistry that Mendeléeff owes his eminence as a chemical philosopher. But it is in the domain of physical chemistry that his fame as a worker chiefly rests. His early papers on the thermal expansions of liquids above their boiling points up to temperatures at which their cohesion and latent heats are *nil*, and at which the liquid becomes gaseous independently of pressure and volume, anticipated the researches of Andrews, and were, in their turn, a development of the observations of Cagniard de la Tour, Wolff and Drion.

The same faculty of perceiving the underlying basis of a physical generalisation is seen in the notable paper which he communicated to our Chemical Society in the year following his election into that body as an honorary foreign member, in which he developed a general expression for the expansion of liquids under constant pressure, analogous to that which expresses Dalton's law of the uniformity of expansion of gases. The formula $V = 1 + kt$ applies only to a so-called ideal gas; in like manner, Mendeléeff's expression is to be regarded only as a first approximation—that is, as applicable only to ideal liquids. In the case of actual liquids the deviations from the ideal form increase not only as the liquid approaches the point of change of state of aggregation, but also augment with diminishing density, increasing cohesion, and diminishing molecular weight, just as Mendeléeff himself showed that the deviations from Dalton's law were related to the molecular weights of the gases. Subsequent observers by applying van der Waals's theory of the relation between pressure, volume, and temperature, have shown that the development of Mendeléeff's formula affords a simple and ready method of calculating the critical temperature of bodies from their thermal expansions as liquids—in other words, of reaching the same constant by a method analogous to that employed by Mendeléeff himself to the observations of Kopp and Pierre.

Mendeléeff's work on the relative densities of aqueous solutions of alcohol takes its place as a classic alongside the works of Blagden and Gilpin, and of Drinkwater and Fownes in this country, and, as in the case of these observations, has been utilised by Continental Governments for the purposes of revenue. These determinations were applied by Mendeléeff to the elucidation of a theory of solution, and in a paper, also communicated to our Chemical Society, he sought by means of them to reconcile Dalton's doctrine of the atomic constitution of matter with modern views re-

speeding dissociation and the dynamical equilibrium of molecules. How far this attempt will be ultimately successful time alone can show. Mendeléeff had little sympathy with the theory of electrolytic dissociation, which, he declared, was not in harmony with the facts of observation, and was of little use in facilitating our comprehension of the true nature of solution. Nor was he more predisposed towards the conception of electrons, although perhaps his belief in the integrity of the atom was hardly so fundamental as that of Dalton, who would have gone to the stake rather than recant his declaration: "Thou canst not split an atom!"

The story of the rise and development of the Periodic Law is so well known that it is unnecessary now to dwell upon it. By a good fortune, which some may regard as evidence of predestination, Mendeleeff lived to see the verification of his predictions in the discovery, in rapid succession, of gallium, scandium, and germanium, and no seer ever prophesied more truthfully. It was the astonishing accuracy of Mendeléeff's prognostications, and the apparent boldness and confidence with which they had been uttered, that profoundly impressed the whole scientific world, and secured for his generalisation a respect and acceptance for which otherwise it would have had long to wait. This generalisation is now woven into the fabric of modern chemistry, and is universally accepted as the only rational basis of classification. Like many other great natural truths, we are able, on looking back, to discern its germs in the tentative efforts of previous thinkers who more or less dimly appreciated the significance of the facts upon which it is based, but it is perfectly certain that Mendeléeff knew nothing of the prior work of De Chancourtois and of Newlands, and was no more influenced by it than was Dalton by Richter or by the "Comparative View of the Phlogistic and Antiphlogistic Theories" of William Higgins. In the memorable Faraday lecture which he gave to the Chemical Society in 1889, Mendeléeff, with a true nobility of mind and a modesty which revealed the real greatness of the man, gave adequate expression to his appreciation of the efforts of his predecessors, claiming for himself only courage and intrepidity in placing "the whole question at such a height that its reflection on the facts could be clearly seen."

The Periodic Law has so far stood the test of experience, and each new extension of the science is consistent with its previsions. The inert gases of the atmosphere find their place in the system, and the only radioactive substance the chemical properties of which have been sufficiently investigated has an appropriate position among its correlated elements. In the old days the followers of Stahl sought to make the conception of phlogiston an all-embracing doctrine. Mendeléeff anticipated these attempts as regards his own generalisation by showing that even the universal ether may be included within his system. In his last paper, published in 1902, entitled "An Attempt towards a Chemical Conception of the Ether," he starts with the assumption that the ether possesses mass, and that it has an atomic weight many times less than that of hydrogen, something of the order of 10^{-6} when $H=1$, that it is monatomic like argon and helium, and that by its small density and extremely rapid motion it permeates all matter and space. The ether thus becomes, not an affection of matter, but a distinct entity capable of being attracted by elements in proportion to the weights of their atoms, and he held that the phenomena of radio-activity could be explained by the gradual emission of this ether from such substances as uranium and thorium which have the highest atomic weights of the elements.

The truth embodied in the Periodic Law has led many to suppose that this generalisation lends support to, and is indeed the proof of, the validity of the assumption of a primordial matter. Mendeléeff himself declined to see that such an inference was warranted. He saw nothing in the law inconsistent with the idea of the individuality of the elements, holding that until it could be definitely shown that one element could be transformed into another, or that ether and matter were mutually convertible, the elements must be regarded as distinct and separate entities, immutable and unchangeable.

Mendeléeff not unfrequently visited this country, and was personally known to many British chemists, to whom he was always welcome. His tall and commanding presence, his fine head, with its tangle of long, wispy white hair, his expressive features, his guttural utterance, the wisdom and originality of his talk, his shrewdness and sense of fun, all stamped him as an uncommon and strong personality, which immediately made its presence felt in any company in spite of the innate modesty of the man. Of wide liberal views, intensely national, and a great power in the University, Mendeléeff was doubtless a thorn in the side of bureaucratic Russia, and it was currently reported that the frequent foreign missions on which he was sent were so many covert attempts to keep him at arm's-length.

Every scientific honour that this country could pay was awarded to him, and he was profoundly touched and deeply grateful for the sympathy and appreciation thus extended to him. On the occasion of his delivering the Faraday lecture it fell to the writer's duty, as treasurer of the Chemical Society, to hand him the honorarium which the regulations of the society prescribe, in a small silken purse worked in the Russian national colours. He was pleased with the purse, especially when he learned that it was the handiwork of a lady among his audience, and declared that he would ever afterwards use it, but he tumbled the sovereigns out on the table, declaring that nothing would induce him to accept money from a society which had paid him the high compliment of inviting him to do honour to the memory of Faraday in a place made sacred by his labours.

T. E. THORPE.

PROF. ANTONINO MASCARI.

BY the death of Prof. Antonino Mascari on October 18, 1906, solar physicists throughout the world, and more particularly those who were his intimates in the Italian observatories, have sustained a severe loss.

Born at Campobello di Mazzara (Sicily) on December 4, 1862, Mascari proceeded in due course to the University of Palermo, where he took the engineering course and obtained his degree in that faculty in 1887. It was while there that he developed the predilection for astronomical investigations, and, under the guidance of Prof. Riccò, worked with that activity and intelligent ability which were the outstanding features of his whole career. He was later appointed to the position of assistant to the Piazzi Foundation, and thus was fortunate enough to be able to continue his association with Prof. Riccò—an association which has proved of inestimable benefit to the study of solar physics.

In 1892 Mascari was appointed first assistant at the Observatory of Catania, where the solar prominence observations, commenced by Tacchini at Palermo in 1872, were continued. Probably only those who have had to use these Italian observations in discussions of collateral phenomena are aware how well this task was performed, and how much the science of solar physics owes to the indefatigable labours

and lucid exposition of Prof. Riccò's worthy successor. This work was continued right up to the commencement of his last illness, and we find that the discussion of the observations for the first semester of 1906 was carried out, and published in the *Memorie*, by Mascari.

Although his chief work lay in the province of solar physics, Mascari will also be remembered as a careful observer in other departments of astronomical physics. At the Catania and Etna observatories he made careful telescopic studies of various planets, Saturn and Venus among others. During the latter part of 1892 he noted several well-marked features on Venus, and, from their persistence in the same relative positions on the disc, he inferred that the short period rotation of the planet was out of the question, thus confirming Schiaparelli's conclusion that the period of rotation is equal to that of the planet's revolution in its orbit. Tacchini's observations of about the same date also confirmed this fact.

Mascari was also an authority on the subject of the agitation of telescopic images, more especially that of the sun due to movements in the earth's atmosphere. In collaboration with Signor A. Cavasino he published an exhaustive memoir on this subject in 1905, discussing the observations of the solar image which were carried out at Palermo and Catania during the twenty-three years 1881–1903.

With Prof. Riccò, Mascari was instrumental in carrying on the work in connection with the Catania zone of the Astrographic Chart and Catalogue, the taking and reduction of a large number of the requisite photographs being due to his personal labours. In 1904 he was nominated adjoint-astronomer at Catania, and took a prominent part in the admirable organisation and direction of the observatory work. But it was in the study of solar physics that Mascari's life-work lay, and it is in solar physics that his loss and the true value of his works will be most keenly recognised. This feeling is ably expressed in an obituary notice by Prof. Riccò, published in the *Astronomische Nachrichten*, to which we are indebted for some of the foregoing particulars.

W. F. ROLSTON.

NOTES

THE death on Tuesday of Prof. H. F. Pelham, president of Trinity College, Oxford, and Camden professor of ancient history in the University, at sixty-one years of age, means a great loss to national scholarship and active study. Prof. Pelham took a keen interest in scientific progress, and while a member of the Hebdomadal Council at Oxford he was always on the side of learning and research. Women's education in Oxford had in him a powerful champion, and Somerville College in particular owed a great debt to him for his enthusiastic service on its council. He did much for the promotion and management of the British School at Athens and the British School at Rome, his zeal on behalf of these institutions being based on the conviction of the value of Greek and Roman life and literature as a subject of scientific study. Prof. Pelham was one of the first members of the British Academy.

IN the course of a letter in Wednesday's *Times*, Prof. E. B. Poulton refers to the efforts which have to be made in this country to induce the official representatives of the nation to assist the advancement of science in any particular direction. Instead of seeking the best expert advice upon any subject in which science can be of service, the Government waits to be memorialised before it can be stimulated into action. "The disheartening distance," Prof. Poulton adds, "which, in this respect, separates us from Germany was forcibly brought to my mind at the meeting of the International Zoological Congress in 1901. The fact that the German Empire is penetrated by a belief in the importance and the dignity of science was impressed upon us by the splendid reception in Berlin, by our meetings in the building of the Reichstag, and by every kind of Governmental and municipal recognition and hospitality. In this country unfortunately the conviction that science is of national importance is almost confined to that small part of the nation which includes the scientific men themselves. They know that the existence of the Empire depends upon science, and that, if disaster should overwhelm the island centre, it will be for want of science. Scientific men can fairly claim that there is love of their country no less than love of their subject in the attempts to conquer indifference and even dislike in those who bear the responsibility and wield the power."

AN aurora was observed in most parts of the United Kingdom last Saturday evening, February 9, and in many widely separated places the display is described as being brilliant. The time of occurrence was chiefly between 6 p.m. and 11 p.m., and it was accompanied by a considerable magnetic disturbance, particulars of which are given by Dr. Chree in our correspondence columns. It is noteworthy that sun-spots have been unusually prominent recently, and that at the present time no fewer than four distinct groups are visible, one of which can be seen with the naked eye. London and, indeed, nearly the whole of the south-east of England was enveloped in a thick fog on Saturday evening, which effectually prevented all possibility of the aurora being seen in this part of the kingdom, but it was seen at Oxford. Reports are numerous from the north and west of England as well as from Scotland and Ireland. Many observers give the colouring as yellow, green, rose red or purple, and allude to the flickering or quivering rays. Writing from Winchmore Hill, Amersham (Bucks), Mr. A. M. Davies says that between 10.30 p.m. and 11 p.m. he noticed that the sky was deep pink or crimson in the N.E. and pale green in the N.W. At intervals beams of light were seen at various points, all radiating from some way below the northern horizon. Sometimes there was also a flickering effect, as though horizontal bands of light and shade rose up in quick succession. Dr. W. N. Shaw, director of the Meteorological Office, has kindly sent us a letter received by him from Mr. G. A. Clarke, the observer at the Aberdeen University Observatory. The following extract from this letter describes the chief characteristics of the display:—"The first faint streamers were seen by me a few minutes before 6 p.m., directed from N.N.W. towards the zenith. About thirty minutes later these had increased in brilliancy, while an extended diffuse greenish glow was visible in the N.E., and a faint white band crossed the zenith from E.N.E. to W.S.W. This band rapidly increased in brightness and size until it finally became a bright greenish-white zone girdling the sky from E.N.E. to W.S.W. horizons, and between 50° and 60° south of the zenith. It passed right through the 'belt' of Orion. At 6.45 p.m. a patch of deep red appeared in the north, accompanied by some very bright greenish-yellow streamers. The streamers increased in quantity, and worked upwards toward the zenith, while the band above-mentioned remained steadily in its position until after 9 p.m. Two other faint bands formed near the zenith, but they were merely transitory. Between 7 p.m.

and 8 p.m. some more red and rosy glows were seen in the N.W., but the prevailing colour was greenish-white. At frequent intervals after 8 p.m. the sky at the zenith was occupied by very rapidly moving wavy bands of pale white, which, though rather confused in direction, yet seemed to possess a distinctly undulatory motion towards the S. The streamers continued to shoot upwards with varying brightness, the points of maximum brilliance being in the N.W. and N.E., and occasionally a slight corona was formed overhead. Probably the most noteworthy feature of the display was the fact that it continued from about 6 p.m. until after midnight."

WE record with regret the death of Lord Goschen on February 7 at seventy-six years of age. The deceased statesman's reputation was chiefly gained in the world of politics, though he was well known as an author, economist, and educationist. His masterly book on "The Theory of the Foreign Exchanges" still remains the highest authority on the subject. Another volume, "Essays and Addresses on Economic Questions," was published as recently as 1905. Lord Goschen showed a keen interest in educational matters, he was an early promoter of university extension, and took a leading part in the movement for the abolition of tests in the universities. He was elected a Fellow of the Royal Society in 1872. He was twice Lord Rector of the University of Aberdeen, and once of the University of Edinburgh. In 1903 he was elected Chancellor of Oxford University in succession to the late Lord Salisbury, an honour he enjoyed until his death.

THE gold medal of the Royal Astronomical Society was presented on February 8 to Prof. E. W. Brown, F.R.S., for his "Researches in the Lunar Theory." Mr. H. F. Newall, F.R.S., was elected president of the society in succession to Mr. W. H. Maw.

THE *Chemist and Druggist* announces that the Paris Municipal Council has voted a credit of 3800 francs (152*l*.) toward a monument to the late Prof. Curie in the Paris School of Physics and Chemistry.

REUTER'S Agency states that Major Powell Cotton has sent home a complete skeleton of an okapi, the skull of which is said to be probably one of the most remarkable specimens ever brought to this country. In addition, there is a beautifully marked and perfect skin in a better condition than that now in the national collection. Major Powell Cotton has also sent to England the skin of a young okapi. All are now at the British Museum.

THE American Geographical Society has awarded the Cullum medal for the year to Dr. Robert Bell, F.R.S., chief geologist of the Geological Survey of Canada, as a mark of its appreciation of the great value of his extensive surveys and explorations during a long period. This is the first time the medal has been presented to a geographer who is not a citizen of the United States, and this fact gives additional value to the award.

AT a general meeting on January 25 of the Paris Société d'Encouragement pour l'Industrie nationale, the gold medal of economic arts for the year 1906, on which is an effigy of Ampère, was awarded to M. d'Arsonval for his investigations in electricity. The society awards every year on the recommendation of one of the six committees of the council, a gold medal carrying the likeness of some leader distinguished in science or art, to the authors—French or foreign—of works which have exercised the greatest influence on the progress of French industry during the six years preceding the award.

WHEN attention was directed last summer to the threatened danger to the continued efficiency of the Royal Observatory, Greenwich, likely to be caused by the London County Council electrical generating station erected half a mile due north of the observatory (NATURE, June 28, 1906, vol. lxxiv., p. 200), a special committee was appointed by the Admiralty to inquire into the working of the station. The committee, which consisted of Lord Rosse, representing the Royal Observatory, Prof. J. A. Ewing, representing the Admiralty, and Sir Benjamin Baker, representing the Council, has now issued its report, and the conclusions arrived at are contained in the following recommendations:—(*a*) The question, both as regards effects of vibration and obstruction through chimneys or discharge from chimneys, to be further reviewed after, say, two years, by which time experience should be obtained with the second portion of the station at work. (*b*) The generating plant for the second portion to be turbines, which, as well as the dynamos, must be of a perfectly balanced type such as has been proved by trial not to cause vibration. (*c*) An undertaking to be obtained that when the plant in the second portion is available for use the reciprocating engines of the first portion shall not in ordinary circumstances be used after 10 p.m., and their use shall be restricted as far as possible after 8.30 p.m. (*d*) The two chimneys of the second portion, at present incomplete, to be not higher than 204 feet above Ordnance datum. (*e*) The discharge of gases both from these and from the existing chimneys not to be materially hotter than the discharge is now from the existing chimneys—namely, about 250° F. (*f*) No further extension of the station to be made beyond the 20,000 kilowatts now contemplated in the equipment of the second portion.

THE annual dinner of the students' union of the London School of Economics took place on February 9. Mr. Haldane, in proposing the toast of the school, said that idealism is the source of power in religion, in war, in science, in organisation, and the London School of Economics owes its strength and vitality to-day to the fact that it was founded by men who believed in large conceptions and who put them into execution without looking to the consequences. Modern applied economics penetrates into every sphere of public life. The result is that the work of such a school as this is not merely to teach but to train. The Chinese Minister, responding, through his interpreter, to the toast of "The Visitors," said when he came to this country, three years ago, there was only a handful of Chinese students here, but now there are more than ten students in the University of London alone, and more than 100 in the whole of Great Britain. Chinese civilisation, he continued, can boast of the three greatest inventions which have revolutionised the whole world—printing, gunpowder, and the mariner's compass. We have improved those inventions with our Western skill and have gradually built up what may be roughly called modern science. It is now the turn of the Chinese, he remarked, to learn modern science from us, and with their Eastern skill to build up the science of the future. Dr. Nansen, who also responded, said there has been a remarkable *rapprochement* between science and practical life as the centuries have marched on. If we go back some centuries we find science living its life to itself without being in touch with practical life at all, but as time passed on science became

the leading energy of modern society To-day no nation can hope to have any success which has not adapted science to its own life The necessity of adapting scientific methods to practical life has become more and more imperative, and it is in fact, the secret of success of any nation to understand the scientific method of organisation thoroughly

THE October (1906) issue of the Proceedings of the Philadelphia Academy contains the second instalment of a paper by Mr H W Fowler on heterognathous fishes (Astyanax and its allies) One new species is made the type of a new genus, while several previously known forms are referred to new subgenera

THE third and fourth parts (issued together) of the eighty-fifth volume of the *Zeitschrift fur wissenschaftliche Zoologie* appeal solely to specialists, the early stages in the development of the ovum in the hedgehog and the formation of the primitive streak in the yolk of the tern forming the subject of two articles, while the third is devoted to the turbellarian worms of the Bernese Oberland

To the January number of the *Entomologist's Monthly Magazine* Lord Walsingham contributes a further instalment of his account of Algerian Microlepidoptera, mainly based on specimens in his own collection, while in both the January and the February issues the Hon Charles Rothschild describes new British fleas A new lantern-fly (Fulgoridæ) infesting bamboos at Darjiling in such numbers as to be termed "a pest" forms the subject of a note by Mr W L Distant in the earlier of the two numbers

IN No 1505 of the Proceedings of the U S National Museum (vol xxxii, p 1) Mr W M Lyon describes and figures a specimen referred to the typical race of the bonte-quagga (*Equus burchelli*) now nearly, if not completely, extinct It was purchased in 1855 from Messrs Barnum, Bailey, and Hutchinson and is now mounted in the National Museum In some details of colouring it differs from the type-specimen figured by Gray, and in this respect comes nearer to one in the Bristol Museum No 1502 of the same publication is devoted to an account, by Mr Lyon of mammals from Butam Island, Rhio Archipelago while in No 1503 Messrs Eigenmann and Bean discuss a collection of Amazonian fishes.

WE have received a separate copy of a paper by Mr G M Thomson on the marine fish-hatchery and biological station at Portobello, originally published in the Transactions of the New Zealand Institute for 1905 Special attention is, it appears, being directed to the life-history of the more important New Zealand food-fishes many of which have unfortunately, usurped names—such as brill, flounder, sole and lemon sole—properly pertaining to European species Some years ago an attempt was made to introduce the European lobster into New Zealand waters, but without success At the date of writing the author states that arrangements were being made for a fresh consignment of these crustaceans which it was proposed to introduce into situations better suited to their requirements

ACCORDING to Fisheries, Ireland, Sci Invest, 1905, No 8, 1907 (this, by the way, being the unsatisfactory abbreviation given of an exceedingly cumbrous and inconvenient title), the season 1905-6 was a most successful one as regards the hatching of salmon and trout, the total output being 6,827,750 salmon 5?2 000 white trout, and 381,000 brown trout fry, the last estimate being, however, probably far below the actual output As regards salmon fry the output exceeds the previous record season by about one million, this excellent result being, as usual, mainly due to the hatching stations at Lismore and Blackcastle Although no record is given (being probably impossible to obtain) as to the percentage of this fry which attains maturity, it seems likely that something has been done to increase this percentage by the greater attention now paid to the proper planting of the fry Recent observations have shown that both salmon and trout fry require food at an earlier stage (long before the absorption of the yolk-sac) when artificially hatched than when naturally reared, and it appears that hitherto the importance of transferring the alevins into suitable waters so soon as they require adventitious nutriment has not been sufficiently recognised

THE Bulletin of the Johns Hopkins Hospital for January (xviii No 190) contains an interesting article by Mr A W Meyer on some characteristics of the medicine in Shakespeare, with a useful bibliography

THE Sanitary Maritime and Quarantine Council of Egypt has published a volume of scientific reports by the members of its medical staff, and edited by the president, Dr Ruffer It includes several valuable papers on cholera vibrios and the diagnosis of cholera, on agglutinins, hæmolytic and hœmosozic sera, nephritis &c

THE papers in the *Journal of Anatomy and Physiology* for January (xli, part ii) are of a technical nature Among others, Mr D F Derry describes certain predynastic Egyptian tibiæ showing flattening for which it is difficult to account Prof Symmers writes on accessory coronary arteries and Dr T Lewis discusses the interpretation of sphygmographic tracings

A VALUABLE bulletin, compiled by Dr G F White, and entitled "The Bacteria of the Apiary with Special Reference to Bee Diseases" has been received (technical series, No 14, U S Department of Agriculture Bureau of Entomology) It summarises the characters of various bacteria which have been isolated both from normal and from abnormal bees In America, "foul brood" appears to be a disease different from the European one and to be due to a bacillus (*B larvae*) distinct from the *B alvei* of Cheshire and Cheyne

WE have received a reprint of an article by Mr P D. Strachan on undulant (Mediterranean) fever in South Africa, showing that this disease is widely distributed in that part of the world The majority of those who had suffered from the fever used goats' milk, and in several instances the blood and milk of some of the goats agglutinated the *M melitensis* The researches of the Mediterranean Fever Commission have shown that in Malta the goats are frequently infected and transmit the microbe in their milk and Mr Strachan's investigations in South Africa thus help to strengthen the view that the disease is mainly conveyed to man by the milk of infected goats

UNDER the title of "Competition in the Production of Raw Silk Mr S Ito has written a valuable treatise on the economics of the silk industry, published as vol ii, part iv of the Journal of the Agricultural College, Sapporo, Japan Commencing with the early records of cultivation in China and its subsequent extension to other countries, the writer proceeds to contrast the conditions

of the industry in China, Japan, and south European countries Finally, he offers some pertinent remarks as to future production and the directions in which improvements may be effected

As an instance of a superstition connected with the moon's phases, Mr E P Stebbing refers in the *Indian Forester* (November, 1906) to a popular idea among the natives of India that bamboos should not be felled when the moon is full on account of the increased danger of attack by boring beetles While, as usual, the argument is unsound, there would appear to be a germ of truth in the superstition, as experiments, inconclusive, it is true, tend to show that the beetles attack bamboos stacked in the shade in preference to those placed in full light; but with regard to the wider question of felling bamboos, there is more reason for believing that this is best performed during months in the cold season when the beetles do not appear on the wing

THE annual report for 1905–6 of the Agricultural Department, Jamaica, has arrived at a time when the sympathy and assistance of the mother country and many of the colonies is being extended to the inhabitants of that island After suffering from a severe hurricane in 1903, agricultural industries were again expanding and the director of the public gardens and plantations in his report records a large increase in the export of bananas, citrus fruits, cocoa, and coffee Reference is made to trial plots of tobacco at Hope Experiment Station and experiments with cassava, showing that the tubers grown for starch provide a serviceable crop for poor soils Date-palm suckers and Kafir plum plants, *Harpephyllum caffrum* are the latest introductions Dr H H Cousins refers in his report to the investigation of the rum industry as the chief line of chemical work

THE December (1906) number of the Journal of the Royal Horticultural Society contains an account of chrysanthemum cultivation in Japan, by Mr S Hayashi, describing the favourite varieties, the preference of the Japanese for light and artistic flowers is well shown in the types chosen for illustration Even more characteristic are the various effects that are obtained by careful and pre-considered treatment, such as stopping stem and branches in succession until as many as a thousand flowers are produced on a single plant The same writer communicates an account of plants grown in Japan for their edible products in which it is noted that the Japanese cultivate tiger lily bulbs for food, but grow cherry trees mainly for show Mr R H Farrer expresses an English opinion on Japanese flowers and among the list of suggested plants alludes to the beauties of *Rhododendron dilatatum, Lithospermum erythroxylon Schizocodon soldanelloides* and *Iris gracilipes*, but owing to the difference in soil and climate it is doubtful whether these plants can be successfully cultivated in the British Isles

AT the Ceylon Rubber Exhibition it was suggested by Dr J C Willis that, instead of, as at present drying the plantation rubber until it only contains about 0 5 per cent of moisture, it might be advisable to block it in the wet, freshly coagulated condition Experiments with this object were at once carried out by Mr Kelway Bamber the Ceylon Government chemist He prepared the rubber with creosote (to prevent decay and mould) and blocked it at once, getting blocks containing about 9 per cent of water. These sold in London for 5*s* 6*d* per lb against 5*s* 7*d* to 5*s* 9*d* for the ordinary dry Ceylon rubber, thus really getting a much better price A circular (Circular and Agricultural Journal of the Royal Botanic Gardens, Peradeniya, vol iv, No 1) has been lately issued dealing with this matter, and it would seem likely that the old way of making dry biscuits or sheets will soon be extinct

THE Geological Survey of Queensland has issued an interesting report (Publication No 201) on Black Ridge, Clermont, by Mr Lionel C Ball The Black Ridge and the country northwards is at present the mainstay of mining in the district The plateau is covered with basalt, which is underlain by Coal measures and auriferous deposits, the gold occurring in the lowermost portion of the basal conglomerate of the Coal-measures It is believed that the gold was brought in by the same percolating waters that carried the cementing material of the conglomerate, and that it was precipitated by hydrogen sulphide Carbonaceous matter and pyrites do not appear to have been the precipitants In another Publication (No 205) Mr Ball describes the Oaks View gold mines near Rockhampton, and the mines of the Talgai and Thane's Creek goldfields

THE last issue of the *Central* contains a most interesting article, by Mr Maurice Solomon, on carbon making and it is especially valuable from the fact that Mr Solomon is able, from personal knowledge, to describe the processes employed in the only British carbon manufactory which has ever produced carbons of satisfactory quality Mr Solomon gives comparative tables of tests on carbons, and voltage records for the same The comparisons are based on tests made by the National Physical Laboratory

THE *Electrical Review* for February 8 contains a description of the radio telegraph installation for signalling across the Wash which has recently been completed by the Amalgamated Radio-Telegraph Company for the Post Office The plant is installed at Hunstanton in Norfolk and Skegness, in Lincolnshire in both instances at the coastguard stations, being operated by coastguard officers appointed by the Admiralty The installation is primarily for coast communication but will be used by the Post Office for experimental work The mast is of the special design which is as yet confined to the De Forest system, being composed of rectangular baulks of timber bolted together, and is 120 feet in height The aerial consists of six 7/20 tinned copper wires and is so arranged as to be readily lowered or raised Illustrations are given showing the general view of the radio telegraph station and diagrams showing the construction of the mast aerial connections, sending and receiving circuits are also interesting The working of the Wash installation commenced on December 1, 1906 and has been most successful a speed of about thirty five words per minute having been obtained in the electrolytic receiver and telephone circuit

IN the January number of the *Journal de Physique* an interesting article on magnetic detectors and the action of electric oscillations is contributed by M Ch Maurain The author comments on the very complex and apparently contradictory results obtained by the recent experiments of various investigators with magnetic detectors In the first part of his paper M Maurain shows (*a*) that whenever electric oscillations act on magnetism under given conditions the result can be foretold, (*b*) on what the result depends In the second part he deals with magnetic detectors on which it is possible to note the action of electric oscillations with regard to hysteresis in a revolving field He refers for his conclusions to a previous article of his in the *Journal de Physique* (June 17 1906) in which he mentions the works of MM Gerosa Finzi and Mai, and to subsequent experiments made by himself

In an illustrated article on "Recent Progress in Wireless Telephony," by Prof. Fessenden, in the *Scientific American* of January 19, an account appears of a public demonstration given by the National Electric Signalling Company at its Brant Rock and Plymouth stations, which are approximately eleven miles apart. During the demonstration, not only speech, but also phonographic talking records and music were transmitted, and were all successfully received with perfect clearness and distinctness. No extraneous noises of any kind were heard in the receiver, the wireless telephone being so far in advance on the usual wire lines. The National Electric Signalling Company has for some years past been working on various devices to get rid of the extraneous noises which have until lately attended any system of wireless telephony. In the recent demonstration a specially designed dynamo was used in these tests capable of giving 80,000 alternations per second, but the usual number employed is from 50,000 to 60,000. It is claimed that, as developed at present, the system is capable of maintaining communication between ships 100 to 150 miles apart, and wireless telephone messages are now being printed on their reception at the receiving station. A new telephone relay is said to have been invented for use in connection with the above system of wireless telephony and a diagram of connections for this for talking between local exchanges is given, but no details of the relay itself are published. We can only hope that a fuller account of these experiments will shortly appear, and that further improvements will follow which, combined with the recent work of Mr. Poulsen and Prof. Slaby, will make wireless telephony of practical value.

Messrs. Rebman, Ltd., have published a translation, by Mr. H. W. Armit, of the fifth German edition of Prof. August Forel's "Hypnotism or Suggestion and Psychotherapy." The book is described in a subtitle as "A Study of the Psychological, Psycho-physiological and Therapeutic Aspects of Hypnotism," and its price is 7s. 6d. net.

A translation, by Mr. F. Legge, of Dr. Gustave le Bon's "L'Évolution de la Matière" has been published by the Walter Scott Publishing Co., Ltd. The original volume was reviewed at length in our issue of September 21, 1905 (vol. lxxii., No. 1873), and reference may be made to that notice for information as to the subjects dealt with by the author.

Travellers to the East will welcome the new guide-book by Mr. A. G. Plate, which Mr. Edward Stanford has published for the Norddeutscher Lloyd Company of Bremen, under the title "A Cruise through Eastern Seas, being a Traveller's Guide to the Principal Objects of Interest in the Far East." The volume, with its profusion of illustrations and its interesting text, should soon become popular. Its price is 6s.

OUR ASTRONOMICAL COLUMN

The French Eclipse Expedition.—From a message published in No. 5 (1907) of the *Comptes rendus* we learn that the French eclipse expedition under the direction of M. Milan Štefánik was unsuccessful owing to the fact that the sky was covered with clouds during the whole eclipse. It would thus appear that none of the official expeditions dispatched from Europe for this eclipse obtained any photographs, for, as we noted previously, the German and Russian observers were equally unsuccessful.

The Spectroscopic Binary *o* Leonis.—An interesting discussion of the system of *o* Leonis is published in No. 4151 of the *Astronomische Nachrichten* by Herr W. Zurhellen. The discussion is based on observations made with the spectrograph of the Bonn Observatory during April, 1905, and April, 1906. The results obtained from numerous lines of each of twelve plates measured are given separately, and then discussed as a whole. The apparent semi-axis of the relative path of the two components is found to be 0.15884 of the sun's distance, whilst the masses of the components relative to the sun's mass are 1.358 and 1.185 respectively.

Stars with Variable Radial Velocities.—Lick Observatory Bulletin No. 107 contains a number of radial-velocity results obtained at the Lick Observatory and by the D. O. Mills expedition to the southern hemisphere. The former set includes the discovery of eight spectroscopic binaries, the latter the discovery of four.

The radial velocity of Antares is also discussed in the same bulletin. A comparison of the earlier with the more recent spectrograms of this star afforded a strong indication of variable velocity, which has been confirmed by new observations and the re-measurement of the old plates. A faint superimposed spectrum is indicated on some of the plates, but this is supposed to be due to the telescopic companion of Antares.

The Recent Maximum of Mira.—In the February number of *Knowledge and Scientific News* Mr. P. M. Ryves discusses a number of magnitude observations of Mira made during the rise to maximum brightness which took place in the latter part of 1906. The observational results, obtained on forty-two days between July 30, 1906, and January 10, 1907, showed that the magnitude on the former date was about 9.0, whereas by October 17 it had reached 7.0. A more rapid rise in brightness then set in, so that by December 2 the second magnitude was attained, that is to say, the light was increased about one hundred-fold in less than fifty days. For the nineteen days between October 26 and November 14 the rise in brightness was particularly abrupt, the star passing from the sixth to the third magnitude. From Mr. Ryves's results the actual maximum appears to have taken place about December 10, 1906 (J.D. 2417555), when the recorded magnitude, on the Harvard scale, was 1.85.

The United States Naval Observatory.—The report of the superintendent of the U.S. Naval Observatory for the year ending June 30, 1906, follows the usual lines of its predecessors. Rear-Admiral Asa Walker succeeded Rear-Admiral Chester as director in March, 1906. In many departments the ordinary routine work was greatly hindered by the preparations for the eclipse of August, 1905, and the absence of a number of the observers with the eclipse expedition. The final plans for a self-registering right-ascension micrometer, for use with the 6-inch transit circle, have been adopted, and the instrument is being made. Solar photographs were obtained on 168 days, and showed spots and faculæ on all but two days. With the meridian and equatorial instruments observations of the normal character were made, and the usual chronometer and time services were well maintained.

Sun-spots in 1905.—The results of the Greenwich measures of sun-spots for the year 1905 appear in No. 3, vol. lxvii., of the Monthly Notices (R.A.S.). The increase in spotted area during the year as compared with 1904 was 144 per cent., the mean daily area, 1191, was greater than that of 1883, but less than the corresponding areas for 1892, 1893, and 1894. The increase in area of the faculæ was about 48 per cent. The mean latitude of the spots during the year, about 13°, points to 1905 as being the year of maximum in the present spot-cycle, although the continued preponderance of the spotted area in the northern hemisphere corresponds with the condition obtaining some two years before maximum in the two preceding cycles. The outstanding feature of the year 1905 was the great number of abnormally large spots, one spot seen from January 29 to February 11 exceeding in area any other spot as yet measured at Greenwich.

No. xcvii. of the *Astronomische Mitteilungen* contains Dr. Wolfer's annual summary for 1905 of sun-spot frequency and heliographic distribution, with which he compares the results obtained from the measures of magnetic declination.

ITALIAN VOLCANIC ROCKS[1]

ALTHOUGH the Tertiary and Recent volcanic tract along the western side of the Apennines is classic ground to the geologist no less than to the historian, we still possess only meagre information concerning the many remarkable, and often unique, rock-types for which these Italian volcanoes have long been famous. A comprehensive and connected study of a large part of the assemblage by a well-qualified authority is therefore peculiarly welcome. Dr. Washington has devoted much attention to the subject both before and since the publication, ten years ago, of his "Italian Petrological Sketches."

"Comagmatic region" is synonymous with "petrographical province," and the author's reasons do not convince us of the necessity of abandoning a now familiar term. The Roman region is defined as extending from Lake Bolsena to the Phlegræan Fields, and probably few petrologists will dissent from the proposition that the community of characters among the volcanic rocks of this region points to a real genetic relationship of the several

Sketch Map of Italian Comagmatic Regions

Roman Region: V — Vulsinian District; Ci — Ciminian District; S — Sabatinian District; L — Latian District; H — Hernican District; A — Auruncan District; Ca — Campanian District; Ve — Vesbian Volcano; P — Phlegræan Fields; I — Ischia; 1 — Montecatini; 2 — Campiglia; 3 — Massa Marittima; 4 — Roccastrada; 5 — Monte Amiata; 6 — Tolfa; 7 — Cervetori; B — Berican Hills; E — Euganean Hills; Vu — Monte Vulture; Et — Etna

Tuscan Region

Venetian Region

Apulian Region

magmas. The author separates, though somewhat doubtfully, the smaller "Tuscan region" lying farther to the north and west, which we hope will be the subject of a future memoir. It can scarcely be denied, however, that a certain community of characters unites all the Italian volcanic districts on this side of the Apennines (with Monte Vulture in the mountain-belt itself), the resemblance being emphasised by contrast with the rocks of the Euganean Hills on the opposite side of the main orographic line.

The body of the memoir before us consists of two parts. The first is purely descriptive, the several rock types being treated in order, succinctly but thoroughly. The special features of this part are the quantitative element constantly introduced into the mineralogical descriptions, and the addition of a large number of new and carefully-made chemical analyses of the lavas. The peculiarity which has made the region famous in petrography is the abundance and variety of leucite-bearing rocks. The non-leucitic types are for the most part of trachytic affinities, though with a proportion of soda lime-felspar which caused the author (in his former papers) to distinguish them under the names vulsinite and ciminite.

The second part of the memoir, discussing the mutual relations of the associated rocks, is headed "Petrology" (the first part being "Petrography"). It would seem more convenient to use the name petrology for the whole science of rocks, including the descriptive branch (petrography) and the rational. The author gives an interesting discussion of the facts which he has brought together, and touches on the genetic problems which underlie those facts. In particular, he attempts a calculation of the average composition of the magmas for the several districts and for the whole region. In the central part of the region all the lavas carry leucite, basic leucite-tephrites and leucitites being largely predominant, while at the two extremities of the region the trachytic types are in greater force. No definite order of succession in time can be made out.

While taking care to make his work intelligible to the ordinary petrologist, Dr. Washington employs throughout the methods and terminology of the Quantitative Classification, of which he is joint author. The memoir thus written does, as he claims, serve to make that system clearer by showing it in actual operation, and this is an incidental gain, but, although it is here seen at its best, as applied to a cognate collection of types, most of which possess strongly marked characteristics, we do not find our fundamental objections to the new classification weakened by a closer acquaintance with it. If a rigidly quantitative, and therefore artificial, classification be desirable, which we do not concede, it might be sought in the actual mineral composition of the rock (here estimated in most cases) rather than in the imaginary composition which is called the "norm." In reading the descriptions and discussions it needs no very perverse fancy to construe many sentences as censuring Nature for departing from the "norm" or commending her for approximately conforming to it, and this air of artificiality must somewhat discount the usefulness of what is undoubtedly a very valuable monograph.

A. H.

[1] "The Roman Comagmatic Region." By Henry S. Washington. Pp. vi+199. (Washington: Carnegie Institution, 1906.)

INVERSION TEMPERATURES FOR AIR AND NITROGEN

THE Bulletin of the Cracow Academy of Sciences for December, 1906, contains a preliminary note, by Prof. K. Olszewski, on the determination of the temperature of inversion of the Joule-Kelvin effect for air and for nitrogen when subjected to different pressures. The apparatus used was similar in principle to that adopted in 1901 in determining the inversion temperature for hydrogen, but details had to be modified owing to the necessity of working at much higher temperatures. The table which follows shows the inversion temperature of the gas when allowed to expand from the initial pressure p (expressed in kilograms per square centimetre) to the pressure of the atmosphere. Above the temperature t a thermo-element showed a heating effect on expansion, whilst below this temperature a cooling effect was observed.

Air		Nitrogen	
p	t_i	p	t
160	+259	159	+243
100	249	126	238
90	244	102	233
80	240	90	228
70	235	80	223
60	226	68	217
40	198	55	205
20	124	30	163

It is seen that the inversion temperature is a continuous function of the pressure, confirming the recent theoretical views of Witkowski and Porter. The value of the in-

version temperature for air, however, calculated by Witkowski from the empirical formula of Rose-Innes, was +360°, whilst the van der Waals formula was found to require an inversion temperature of +500°, in the latter case, however, the calculation is based on the assumption of a small difference of pressure (1 atmosphere) accompanying the expansion, whilst the experimental values refer to expansion over a wide range of pressure. The shape of the curve for air connecting the inversion temperature with the initial pressure at which expansion occurs shows that below 80 atmospheres a rapid fall of the inversion temperature occurs as the pressure is diminished. Very little cooling effect is therefore to be anticipated with air allowed to expand from pressures below 80 atmospheres; such, indeed, is actually observed to be the case, liquefaction only taking place readily in the apparatus described by Prof. Olszewski in 1902, so long as the initial pressure does not fall below this limit.

STUDENTS IN GERMAN UNIVERSITIES

ACCORDING to the *Chemiker Zeitung*, the total number of matriculated students in attendance at the German universities during the present winter semester is 45,136, as against 44,942 last summer, and 42,390 in the preceding winter; five years ago the attendance was 35,518, ten years ago 30,043, twenty years ago 27,080, and thirty years ago, that is, in the winter 1876–7, it was only 17,457, upon which total the present number shows an increase of 27,679, or 159 per cent. It is of more than passing interest to compare the number of students at the different universities to-day with those of thirty years ago:—

	1906–1907	1876–1877		1906–1907	1876–1877
Berlin	8188	2490	Tübingen	1522	903
Munich	5567	1280	Marburg	1503	382
Leipzig	4466	3036	Würzburg	1407	1028
Bonn	2992	793	Jena	1275	439
Halle	2250	854	Konigsburg	1140	621
Breslau	1961	1219	Giessen	1097	318
Gottingen	1831	991	Erlangen	1056	474
Freiburg	1744	293	Kiel	877	219
Strassburg	1652	707	Greifswald	827	468
Heidelberg	1603	473	Rostock	645	156
Munster	1533	313			

The distribution of these students in the various branches of academic study is as follows:—

	1906–1907	1876–1877
Law students	12215	4835
Art students	10873	3874
Medical students	7035	3374
Mathematical and science students	6116	2009
Evangelical theology	2208	1518
Pharmaceutical students	1865	680
Catholic theology	1708	1164
Students of economic sciences and forestry	1235	155
Agricultural science	985	369
Dentistry	870	8
Veterinary Science (only matriculated at Giessen)	110	0

Against these numbers it is to be remarked that the large number of applied and pure science students attending the Technische Hochschulen is not included here, while the number of arts students is too high by nearly 1000, owing to the modern custom in the Prussian universities' returns of including among such students those whom they place under the tabulation heading "Sonstige Studienfächer der philosophischen Facultat."

Out of a total number of 45,136 students in attendance at German universities during the present winter half-year 4151, or 9·2 per cent., are described as foreigners, against 8·6, 8·4, and 7·5 per cent. in the preceding half-years. The absolute increase of 596 on the number for the corresponding semester of last year (namely, 3555) is almost exclusively due to an increase in the number of Russian students, who have increased from 1320 to 1890 in one year. Of the 3717 students belonging to European countries, 681 are from Austria, 341 from Switzerland, 144 from England, 139 from Bulgaria, 83 from Roumania, 61 from Servia, 58 from France, 57 from Holland, 53 from Luxemburg, 47 from Greece, 40 from Turkey, 33 from Italy, 32 from Scandinavia, 23 from Spain, 19 from Belgium, 9 from Portugal, and 5 from Denmark. From America, mainly from the United States, are 302; from Asia, chiefly Japanese, 113; from Africa, 13; and from Australia 6. The distribution of this foreign element at the universities is as follows:—

University	Foreign students Number	Per cent.	University	Foreign students Number	Per cent.
Berlin	1189	14·5	Giessen	84	7·6
Leipzig	662	14·8	Breslau	77	3·9
Münich	496	8·8	Würzburg	67	4·7
Heidelberg	259	16·1	Marburg	60	4·9
Halle	254	11·3	Tübingen	59	3·9
Jena	186	14·6	Greifswald	43	5·2
Gottingen	169	9·2	Erlangen	28	2·6
Freiburg	164	9·4	Rostock	13	2·0
Konigsberg	134	11·7	Kiel	12	1·4
Strassburg	96	5·8	Munster	11	0·7
Bonn	88	2·9			

These foreign students are taking as their chief studies:—evangelical theology, 185; Catholic theology, 34; law, 580; medicine, 1080; philosophy, languages, or history, 951; mathematics and science, 714; agricultural sciences, forestry, &c., 573; dentistry, 24.

STANDARD ELECTRIC GLOW LAMPS

THE report of the Engineering Standards Committee on the British standard specification for carbon filament glow lamps, which has recently been issued, is of great interest, more especially as it has been published at a time when so many important papers and discussions on carbon and metallic filament lamps are occupying the attention of men of science and engineers. The specification gives at the beginning a list of standards and definitions, and goes on to state what the committee has decided as to the tests a standard lamp shall comply with. A lamp of 12 candle-power is suggested in addition to the usual 8, 16, 25, and 32, and this should prove a very useful size; although it has already been used, it has not been kept as a stock lamp usually. The standard lamps are to be divided into two classes, having a useful life of 400 and 800 hours respectively, and all lamps purporting to be British standard lamps are to be marked with the trade mark or name of manufacturer, the standard mean horizontal candle-power, the voltage, and a reference letter in a circle, which is to show which class—whether 400 or 800 hours—the lamp is intended for. This reference letter is, we think, a mistake, as the ordinary consumer will not know to what it refers, and we do not see the objection to marking plainly on the lamp the useful life hours. The insulation resistance between cap and filament seems to us to be rather high (1000 megohms). The limits for mean horizontal candle-power and total watts, on the other hand, allow plenty of margin, but doubtless these will be reduced after the standards have come into force, which we understand they will do in July next. At present, however, we do not see that the ordinary consumer will benefit very greatly by the specification when it does come into force, for, as we pointed out a few months back, unless the borough councils or local authorities erect special testing laboratories where tests on lamps can be carried out by an expert for a very small fee, or even free of cost, the ordinary consumer will be in practically the same position as he is at present. Of course, the fact of his being able to ask for a standard lamp may tend to make the article sold him slightly better, and with truer candle-power and consumption figures marked on, still, we are afraid that, from the consumer's point of view, until he can get his lamps tested locally, not very much improvement will be seen. The report is, however, of very great interest to those connected with that branch of the electrical profession, and is certainly a long step in the right direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Government of the French Republic has, by a decree of the Minister of Public Instruction and Fine Arts, conferred upon Prof J Wertheimer, the principal of the Merchant Venturers' Technical College, Bristol, the order of Officier d'Académie

DR DONALD MACALISTER, fellow and director of medical studies of St John's College, Cambridge, Linacre lecturer of physic, and president of the General Medical Council, has been appointed principal of the University of Glasgow in succession to the late Principal Story

M LIARD, Vice-Rector of the University of Paris, has informed the Paris Municipal Council that it is the intention of the University of London to return the visit made to it last year by the Paris University The representatives of the University of London are to arrive in Paris in the middle of May, and a luncheon will be given at the Hôtel de Ville to the members of both universities

MR F DARWIN has been nominated to represent the University of Cambridge at the celebration of the two-hundredth anniversary of the birth of Linnæus, to be held at Upsala in May Dr Hill, Dr A Caldecott, and Mr D H S Cranage have been nominated to represent the University at a federal conference on education, convened by the federal council of the League of the Empire, to be held in London on May 24 to June 1

IT would be difficult to find a more useful book for parents selecting a school for their sons than the "Public School Year-book" (Swan Sonnenschein and Co, Ltd price 3s 6d net), the eighteenth issue of which has just appeared Full particulars of all the schools represented at the headmasters' conference are given, and these are supplemented by much useful information about preparatory schools, the entrance to the professions, public examinations, and kindred subjects

WE have received from Washington copies of the reports of the librarian of Congress and of the superintendent of the library building and grounds for the fiscal year ending June 30, 1906 The amount expended on the library during 1906, exclusive of sums spent on printing and binding reached 117,500l During the same year the net accessions to the library were nearly 35,000 The librarian's report gives interesting particulars of numerous bequests and gifts to the library and information concerning the complete system of cataloguing which has been elaborated The second report deals with such matters as the cost of care and maintenance

HIGHER education in the United States continues to benefit by the generosity of public-spirited American men of wealth We learn from *Science* that an announcement has been made that Mr J D Rockefeller will endow the University of Chicago with 600 000l to maintain a pension fund, the institution having been excluded from the scope of the Carnegie foundation, owing to its denominational control It is also reported that Mr Rockefeller has agreed to give 400 000l for the endowment of a university for Louisville provided a similar amount is raised by those interested in the new institution The chair of chemistry at the University of Pennsylvania has been anonymously endowed by a gift of 20,000l Mr S W Bowne has given to Syracuse University a chemical laboratory, costing 20,000l Finally the packing interests of Chicago have offered to the University of Illinois the sum of 50 000l with which to establish in that city a veterinary college

MR J D ROCKEFELLER has given the General Education Board, which is designed to help educational institutions 6,400,000l for the purpose of assisting the work of the Board throughout the country Referring to this announcement, the New York correspondent of the *Times* remarks that the donation is believed to be the largest single sum ever given for a philanthropic purpose So far as is known, Mr Rockefeller has up to the present made donations for educational purposes amounting to a total of 18,000,000l, and he is believed to have given anonymously 6,000,000l more The General Education Board will now be in a position to aid educational institutions all over the United States No State universities share in its gifts, and in every case the Board endeavours to encourage institutions which may eventually come to be self-supporting rather than those dependent on charity for their maintenance

THE report of the higher education subcommittee of the London County Council, which was adopted at a recent meeting of the Council, recommends that certain grants be made to the governors of fifty secondary schools The total amount available out of the current estimates is 120,000l It is estimated that 11,945l will be required in respect of the building grants voted in March, 1906 The proposals amount to 74,825l, of which 2355l is for equipment Last year the corresponding figures were 66,745l, of which 3895l was for equipment This represents a gross increase of 8080l, of which about 6000l may be taken as the cost of the education of the increased number of the Council's scholars To make the comparison accurate, however this sum should be increased by 1789l, the amount of the grants paid last year, which for different reasons are not included in this year's list The net increase in aid, apart from the cost of the Council's scholars, is therefore under 4000l

DR M W TRAVERS, F R S, who is at present making a tour in India in connection with the Tata Research Institute of which he is the first director, has, the *Pioneer Mail* reports expressed disappointment at the standard required for degrees in science at Indian universities In chemistry the courses are defective, Dr Travers finds few of the universities introduce quantitative practical courses and the theoretical courses are hardly up to the intermediate standard of English universities The lack of suitable students among bachelors of science will be a drawback to research in the Tata Institute and may lead to a difficult situation Indian universities have hitherto confined their research courses to masters of arts or science who have received two years' special training after graduating The total number of research students in all the Indian universities is probably considerably less than twenty It is consequently feared that there may be a difficulty in supplying the Tata Institute with properly qualified students

THE report of the Departmental Committee on Education Rates, appointed in October, 1905 has been published as a Blue-book (Cd 3313) An important section of the report deals with expenditure on higher education—in this connection an elastic term including all forms of instruction other than elementary A summary relating to the rates required in 1905-6 by county and county borough councils for the purposes of higher education, shows that the councils of nineteen counties raised no rates for higher education at all and that seven county borough councils had the same unenviable notoriety Of the forty-three counties levying such a rate sixteen required something under 1d in the pound nineteen under 2d, seven (including the London County Council) less than 3d, and one between 3d and 4d Of sixty five councils of county boroughs one (West Ham) required more than 5d in the pound, three more than 4d but less than 5d, nine more than 3d but less than 4d six more than 2d but less than 3d thirty four more than 1d but less than 2d, and twelve less than 1d The sum of 2,477 327l was devoted in 1904-5 to higher education of the kind explained and of this amount 31 5 per cent was raised by rates 20 6 per cent was received from the Board of Education and 38 1 per cent was allocated from Exchequer contributions The report states as indeed is much to be hoped that the expenditure of local authorities in respect of higher education may be expected to continue to increase in amount Altogether, the Blue-book provides an abundance of useful information

THE fourteenth annual general meeting of the Association of Technical Institutions was held on February 8 and 9 in London The meeting was preceded by a luncheon given to the members of the association by the Clothworkers' Company Sir Horace Plunkett the president for 1907 delivered an address, during which he said that among the many admitted defects of our educational system there is one most hopeful sign—the evening technical institutes, of which we may be justly proud It is true

that their very success emphasises the defectiveness of the present condition of things in regard to higher technical training This condition is due to the difficulty of securing attendance at day courses in our many excellent institutions There has been some improvement in this respect, but the number of students taking systematic higher courses is lamentably small Sir Horace Plunkett is convinced that the tendency to bring the instruction in the evening technical institutes into the closest relationship with industrial requirements will go far to secure what is admittedly one of the most important desiderata to-day—the cooperation of employers and workers It must be frankly recognised that the *raison d'être* of the evening technical school is industrial efficiency, that the apprenticeship system under modern industrial conditions must fail to educate the young worker effectively, and that the evening technical school must now undertake some of the teaching previously conferred in the workshop The great usefulness of American technical institutions is due in a large measure to the individual interest taken in the students, not only during their attendance at the school, but during their subsequent career The following papers were read and discussed —The cooperation of adjacent authorities in the supply of higher technical education by Principal A F Hogg, of West Ham and monotechnic institutions, by Mr Charles Harrap of the St Bride Foundation Institute, London

SOCIETIES AND ACADEMIES

LONDON

Royal Society November 1 1906 —"The Nitrification of Sewage" By Dr G **Reid** Communicated by Prof Gotch F R S

The author gives an account of certain observations he recently made which point to the conclusion that by using fine-grain filter particles the depth of percolating filters may be greatly reduced A filter composed of ⅛-inch medium, which had been in constant use for three years, was tapped at four depths in such a way that samples could be collected to show the degree of purification effected at 1-foot intervals downwards, and the conclusions arrived at are based upon the analysis of numerous samples collected during a period of about twelve months, the delivery to the filter being constant throughout and at a rate of 200 gallons per superficial yard As regards the organic matter, both in suspension and solution in the septic tank effluent applied to the filter, the author found that the work of purification was effected at a depth of 1 foot from the surface, leaving very little work for the deeper layers to accomplish

The following are the means of the more important figures of analyses —

—	Parts per 100 000				
	Septic Tank	1 ft	2 ft	3 ft	4 ft
Solids in Suspension	7.60	0.25	0.09	0.14	0.00
Free Ammonia	1.716	0.036	0.020	0.009	0.043
Albuminoid Ammonia	0.340	0.052	0.037	0.031	0.027
Oxygen absorbed in 4 hours at 80° F	2.184	0.328	0.286	0.244	0.259
Nitrous Nitrogen	0.000	0.003	0.007	0.008	0.002
Nitric Nitrogen	0.00	2.07	1.99	1.85	1.99

As regards the carbonaceous matter, the oxidation appeared to be equally rapid for not only did the reduction in oxygen absorbed reach practically its maximum at 1 foot depth, but the air collected from the filter at different depths gave the following amounts of CO_2 per 1000 —1 foot, 19.5; 2 feet, 21.5; 3 feet, 20.0; 4 feet, 20.0 As regards the suspended organic solids, they are practically all retained within the first foot where liquefaction is effected (it is suggested by anaerobic organisms) In confirmation of this, the following mean figures of percentage loss on ignition of filter particles taken from different depths are given —6 inches 3.25, 1 foot, 0.99, 2 feet, 0.65, 3 feet, 0.53, 4 feet, 0·53

As regards the remarkable increase in the free ammonia in the samples from the lowest tray, it is suggested that the circumstance may be accounted for by a revival of anaerobic changes, the result of the asphyxiating effect of the products of combustion produced above

Anthropological Institute, January 22.—Annual General meeting —Prof W Gowland, president, in the chair —Address on the dolmens and burial mounds of the early emperors of Japan the **President.** It is extremely probable that the Japanese obtained the idea of raising mounds from the Chinese, the earliest burial mound in China dating from 1848 B C Little is known about the earliest Japanese mounds, but the later ones are always more or less large, and invariably contain either a sarcophagus or dolmen There is an extremely large number of these mounds in Japan, and Prof Gowland himself examined 406 It is of interest to note that the dolmens are always near the coast or in the basins of the larger rivers, which points to the fact that at the time of their erection the Japanese only occupied these districts, the other parts of the country being inhabited by the primitive aborigines—the Ainu The distribution of the early Imperial mounds is also of importance historically They are found in four districts, which goes to prove that at an early date the country had no central Government, but that there were at least four independent tribes each occupying one of the districts where the large Imperial mounds are found The date of these mounds is between the second century B C and the fifth or sixth of our era As to the mounds themselves, the Imperial ones are double, with a conical peak at one end They are all of very great size, and are terraced and moated In plan they are seen to be a combination of the square and circular varieties, but whether this has any significance is not known One interesting feature is that round each terrace a series of terra-cotta tubes—"Haniwa"—about 18 inches high and 15 inches broad, are set in rows They may have been placed there for structural reasons, or they may represent the wives, attendants, &c, who formerly were buried with the emperor This practice was discontinued in 2 B C, and by an Imperial decree terra-cotta figures were substituted for the human victims Many of these figures have been found and in some cases they terminate in a "Haniwa" The largest of the Imperial mounds are in the central provinces, the largest of all is 2000 feet long and covers approximately an area of eighty-four acres The interment is always in the conical peak of the circular part of the mounds They are, as a rule entirely artificial but occasionally a natural eminence has been turned to account

Physical Society, January 25 —Prof J Perry, F R S, president, in the chair —The strength and behaviour of brittle materials under combined stress W A **Scoble** The results described in the paper are a continuation of a series obtained from tests on a ductile material The bars were of cast iron, ⅞-inch diameter, 30 inches between the bending supports, subjected to bending and twisting to fracture The maximum principal stress and the maximum shear, calculated on the assumption that there was no yield, each varied about 40 per cent Plotting the corresponding bending and twisting moments, the points lie on an ellipse, the twisting moment being about 3000 lb inches, and the bending moment 2200 lb inches at fracture In all cases, except that of simple bending, the fracture was a spiral, completed by a part making a small angle with the axis and invariably coming under the knife-edge —Recent improvements in spectrophotometers F **Twyman.** The paper deals with a form of Hüfner spectrophotometer designed in 1904, and consists of two parts —(A) The evaluation of the errors due to the polarisation produced by the dispersion-prism and by the Hüfner rhomb which brings about the accurate juxtaposition of the two beams of light the intensities of which are to be compared, and the method by which in the recently constructed instruments it is arranged for these effects to neutralise one another (B) The use of the instrument as a spectropolarimeter by placing in the space between the dispersion-prism and the second Nicol the media the optical rotations of which it is required to measure

Challenger Society, January 30.—Mr. E. W. L. Holt in the chair.—Fishes captured by the Marine Biological Association's fishery steamer *Huxley* in November, 1906, at the channel entrance from the Bay of Biscay: L. W. **Byrne.** The collection was chiefly interesting as providing records of species already known from deeper water, *e.g.* *Synaphobranchus pinnatus*, and *Scopelus glacialis*, *S. punctatus*, and *S. crocodilus*. Attention was also directed to specimens of the little-known *Onos biscayensis* and the recently described *Pteridium alleni*.—The Decapoda collected by H.M.S. *Research* in the Bay of Biscay, 1900: S. W. **Kemp.** The chief interest of this collection was in a fine series of *Acanthephyra purpurea*, which ranged from the length of 4.3 mm. up to an adult of 81 mm. Unlike *A. debilis*, in which Coutière has shown that the larva is hatched with peræopods, uropods, and pleopods fully formed, this closely allied species leaves the egg as a Zoæa. The series of larvæ was fully described and figured, and shows a remarkable reduction at a certain stage of the cornea and rostrum, followed by their subsequent growth. Other interesting captures were *Sergestes arcticus*, *Gennadas parvus*, and *Acanthephyra debilis*. The author also described and figured an unknown larva allied to Caricyphus of Spence Bate.

Society of Chemical Industry (London Section), February 4.—Mr. R. J. Friswell in the chair.—Chemical composition of some motor-tyre rubbers: Dr. P. **Schidrowitz** and F. **Kaye**. The authors conclude (1) that in many cases tyre trouble is directly referable to chemical defects (such as over or under curing, unsuitability of the quality of the rubber, excess of mineral matter, &c.) of the rubber mixings; (2) that manufacturers are by no means agreed as to nature and quantity of the various ingredients and conditions of manufacture to be employed; (3) that it is apparent from the widely divergent results obtained in some cases with tyres of the same size and make that the process of manufacture is not always conducted on sound scientific lines, but, on the other hand, they point out that some of the results of their investigations indicate that even and constant quality may be obtained by adequate supervision of manufacture.—Composition of some new crude rubbers: Dr. P. **Schidrowitz** and F. **Kaye**. The authors give the results of examination of rubbers from the newer sources of supply, such as Ceylon, Uganda, and Malaya, and also of a sample of *Castilloa elastica* from Mexico. The results of experiments on a series of Ceylon biscuit rubbers distinctly support the view that it is a mistake to turn out rubber in thin biscuit form, and the authors make some observations on the apparent nature of the changes produced in rubbers prepared in this manner. They also describe a modification of the Ditmar method of analysis of crude rubbers which they have devised, and give some preliminary figures referring to the nature of the proteids, resins, and mineral matters in some of the rubbers examined.—Sources of carbon dioxide in the determination of nitrogen in organic compounds by the absolute method: C. **Young** and B. **Caulwell**. The authors described a modification of Theile's apparatus (*Annalen*, 1889, 253, 242) for the evolution of carbonic acid in an external generator. The design of the mercury trap and safety tube are novel. The carbon dioxide produced is claimed not to contain 0.1 c.c. of air per 5 litres.

PARIS.

Academy of Sciences, February 4.—M. A. Chauveau in the chair.—The secretary announced to the academy the death of Prof. Mendeléeff.—Researches on the solar atmosphere. Vapours with dark lines and clusters of particles: H. **Deslandres** and L. **d'Azambuja**. A detailed account of the work done at the Observatory of Meudon during 1906 with various forms of apparatus.—Autopsy of the African elephant "Sahib" which died on January 29 at the Museum: Edmond **Perrier**.—Determinism of the superiority of the energy expenditure due to the assimilation of albumenoid foods: A. **Chauveau**. The author's experiments are described in detail. Of the numerous conclusions drawn from these results, the most important is that it is necessary to give up the use of the heat of combustion as a guide in the theory of food.—A new contribution to the study of trypanosomiasis of the Upper Niger: A. **Laveran**. A study of a new species closely allied to *Trypanosoma dimorphon*, arising from the blood of an infected sheep. A close comparison of *T. dimorphon* with the new organism shows that the two are not identical, and the name *T. pecaudi* is proposed for the new species.—The relation between falls of barometric pressure and the evolution of fire-damp in mines: G. **Bigourdan.** A comparison of the times of the colliery explosions in the Lens and Saarbruck basins on January 28 with the heights of the barometer shows that here, as in other cases, the explosions occurred at the time of a rapid fall of the barometer following a long period during which the readings of the barometer had been high.—Prince Roland Bonaparte was elected a member in the place of the late Raphael Bischoffsheim.—Some new variable stars with very rapid variations in light intensity: Jules **Baillaud**. In the photography of the chart of the sky the negative receives small successive displacements at intervals of thirty minutes, so that each star is represented by three contiguous images. These images will be similar if the condition of the sky has not changed, different if it has varied, but in the latter case all the images will be affected similarly. In some of the photographs obtained at Paris during 1906 several of these triple images vary considerably in the intensity of the images, and two at least of these cases appear to be due to very rapid variations in the brightness of the star. In one instance the three images are respectively of magnitudes 14.5, 13, and 12.7. Of the forty plates examined this year by MM. A. Boinot and J. Baillaud, containing more than 50,000 stars, only three other stars have been found exhibiting this peculiarity, and two of these are due to a grain of dust on the plate.—The quadrature of curved surfaces: Zoard **de Geöcze**.—The comparative study of helices and aeroplanes: P. **Tsoucalas** and J. **Vlahavas**.—The refraction of compound gases: Jules **Amar**. The author examines the proposition that the refraction of a compound gas is the sum of the refractions of the atoms which enter into the molecule, and shows that this proposition holds within the range of experimental error.—The resonance phenomena in the case of transformers with open magnetic circuit, and their utility in the production of strong electric sparks: G. A. **Hemsalech** and C. **Tissot**. Resonance effects are generally avoided in alternating-current circuits on account of the harmful results on the insulation, but there are certain cases in which there is a considerable advantage in establishing resonance, and one of these is the production of powerful electric sparks. An account is given of the construction of a coil in which this resonance effect is utilised. A transformer of the type described is useful not only in spectroscopy, but also in wireless telegraphy.—Experimental researches on dielectric solids: Louis **Malclès**.—An attempt at a theory of phosphorescence and fluorescence: J. **de Kowalski**. A development of some views of Prof. J. J. Thomson on the production of light under the influence of electric discharges. The theory is in general agreement, both qualitatively and quantitatively, with experiment.—The molecular weights of various gases calculated by the method of critical densities: Daniel **Berthelot**. Regarding the correction for the compressibility of a gas, the author points out that it is not a matter of indifference which formula is used for the variation of pv. This expression has been taken as a linear function of the density or of the pressure; the former is correct. The atomic weight of chlorine, deduced from the density of hydrochloric acid, falls between 35.454 and 35.478; that of sulphur, from sulphur dioxide, between 32.050 and 32.064.—The ethyl ether oxide of *αα*-dichloro*iso*propyl alcohol and on dibromoacetic aldehyde: P. **Freundler**. A preliminary notice indicating the line of work on which the author is engaged.—Some reactions of sodium amide: Louis **Meunier** and J. **Desparmet.** Sodium amide reacts with ethylene bromide, the products being acetylene, ammonia, and sodium bromide. With chloroform the reaction starts with difficulty, but once started becomes explosive, ammonia together with a mixture of sodium chloride and cyanide resulting.—The application of sodium amide to the preparation of diphenylbenzylamine, sodium diazo-

amidobenzene, and the sodium derivative of ethyl malonate is described —The composition of the plant juices extracted from stems and leaves G **André**.—The chemical composition of the Koch bacillus and its binding material Relation with resistance to acids Jules **Auclair** and Louis **Paris**. The fatty matters were extracted by successive treatments with alcohol, ether and chloroform, petroleum ether alone being incapable of extracting the whole of these substances These fatty matters, the protoplasm, and cellulose all give the Ehrlich reaction —Autopsy of the African elephant "Sahib," which died at the Museum on January 29 Mme Marie **Phisalix** The death resulted from an accidental chill, leading to inflammation of the lungs, there being no sign of any chronic disease —A new view of the Blastodinidea (*Apodinium mycetoides*) Edouard **Chatton** —The chain of the Puys and the lesser Puys Ph **Glangeaud** —Note on the Palæozoic strata of the eastern edge of the Central Plateau Albert **Michel-Lévy** —The direction of the earlier folds in the central and eastern Pyrenees Léon **Bertrand** —The age of the Eocene deposits of the Armorican massif and of the Ronca zone Jean **Boussac**.

GÖTTINGEN

Royal Society of Sciences —The *Nachrichten* (physico mathematical section), part v for 1906, contains the following memoirs communicated to the society —

July 28 —Questions of crystal-physics, ii, the action of a magnetic field on the optical behaviour of pleochroitic crystals W **Voigt**.

October 27 – Real and apparent "transgredient stratification" A **von Koenen** —Measurements of the ionisation and radio activity of the air over the open sea (Atlantic and Pacific) F **Linke**.—Meteorological kite observations in Samoa F **Linke**.—Fuchsian integrals J **Thomae**.

December 8 —The behaviour of sulphides of the heavy metals in aqueous solution Oskar **Weigel**

DIARY OF SOCIETIES

THURSDAY, FEBRUARY 14

ROYAL SOCIETY, at 4 30.—On the Purification and Testing of Selenion R Threlfall F R S —On the Specific Inductive Capacity of a Sample of Highly Purified Selenium O U Vonwiller and W H Mason —Investigation of the Law of Burning of Modified Cordite Major J H Mansell, R A —The Thermomagnetic Analysis of Meteoric and Artificial Nickel Iron Alloys S. W J Smith

ROYAL INSTITUTION, at 3 —The Minute Structures of Igneous Rocks and their Significance Alfred Harker, F R S

SOCIETY OF ARTS, at 4 30 —The Practical Side of Famine in India Sir Frederick S P Lely K C I E

LONDON INSTITUTION at 6 —Scientific Method Prof H E Armstrong, F R S

MATHEMATICAL SOCIETY, at 5 30. —Groups defined by the Order of the Generators and the Order of their Commutator Prof G A Miller —On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of a Pellian Dr I Stuart —On Repeated Integrals Dr E. W Hobson —The Construction of the Line drawn through a Given Point to meet Two Given Lines Prof W Burnside

FRIDAY, FEBRUARY 15

ROYAL INSTITUTION at 9 —Foraminifera J J Lister F R S

INSTITUTION OF MECHANICAL ENGINEERS, at 8 —Annual General Meeting

SATURDAY FEBRUARY 16

ROYAL INSTITUTION, at 3 —Röntgen, Kathode, and Positive Rays Prof J J Thomson F R S

MONDAY, FEBRUARY 18

VICTORIA INSTITUTE, at 4 30 —The Spread of the European Fauna Prof J Logan Lobley

TUESDAY, FEBRUARY 19

ROYAL INSTITUTION at 3 —The Visual Apparatus of Man and Animals: Prof William Stirling

ROYAL STATISTICAL SOCIETY, at 5

ZOOLOGICAL SOCIETY, at 8 30

FARADAY SOCIETY at 8 —The Present Position and Future Prospects of the Electrolytic Alkali and Bleach Industry J B C Kershaw

INSTITUTION OF CIVIL ENGINEERS at 8 –(*Continued discussion*) Modern Motor vehicles Col R E B Crompton C B

WEDNESDAY, FEBRUARY 20

SOCIETY OF ARTS, at 8 —Cold Storage and Food Supply Hal Williams.

ROYAL MICROSCOPICAL SOCIETY, at 8 – An Early Criticism of the Abbe Theory J. W Gordon —Some Tardigrada of the Sikkim Himalaya James Murray —On Some Rhizopods from the Sikkim Himalaya Dr Eugene Penard —*Exhibition* Slides of Marine Zoological Objects lent by Mr Flatters.

ROYAL METEOROLOGICAL SOCIETY, at 7 30 —Report on the Phenological Observations for 1906 E. Mawley —The Metric System in Meteorology R Inwards

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers* The Estimation of Chloroform in the Blood of Anæsthetised Animals G. A Buckmaster and J. A Gardner —On Electrical Seed Testing Prof. T. Johnson.—On Longitudinal Symmetry in Phanerogamia Prof Percy Groom.—And other Papers

ROYAL INSTITUTION, at 3 —The Minute Structure of Igneous Rocks and their Significance Alfred Harker, F R S

CHEMICAL SOCIETY, at 8 30.—The Constitution of Oxyazo-compounds W B Tuck —The Influence of Solvents on the Rotation of Optically Active Compounds, Part ix, A New General Method for Studying Intramolecular Change T S Patterson and A. McMillan —The Reduction Products of ortho and para-Dimethoxybenzoin J C. Irvine and A M Moodie —Replacement of Halogens by Hydroxyl, i, The Hydrolytic Decomposition of Hydrogen and Sodium Monochloroacetates by Water and by Alkali, and the Influence of Neutral Salts on the Reaction Velocities G Senter —The Reaction of Ammonium Salts with the Constituents of the Soil A D Hall and C T Gimingham

LINNEAN SOCIETY, at 8 —The Percy Sladen Trust Expedition to the Indian Ocean, Introduction, Part I, Ceylon to Mauritius J Stanley Gardiner, —Land Nemerteans with a Note on the Distribution of the Group: R C Punnett —Land Crustaceans L A Borradaile —Hymenoptera P Cameron —Dragon Flies F F Laidlaw —Fourmis des Seychelles, Admirantes, Farquhar et Chagos Prof A Forel —Pycnogonidæ G H Carpenter

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Lecture on "Modern Theory of Conduction of Electricity in Metals Prof J J Thomson, F R S

FRIDAY, FEBRUARY 22.

ROYAL INSTITUTION, at 9 —Flame in Gas and Petrol Motors Dugald Clerk

PHYSICAL SOCIETY, at 5 —Transformer Indicator Diagrams Prof Lyle —Ionisation of Gases by α Particles of Radium: Prof Bragg —A Micro manometer B Roberts

INSTITUTION OF CIVIL ENGINEERS, at 8.—Impurities in Boiler Feed water, their Nature, Effect and Elimination F. E Walker

SATURDAY FEBRUARY 23

ROYAL INSTITUTION, at 3 —Röntgen, Kathode and Positive Rays Prof J J Thomson, F R S

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THURSDAY, FEBRUARY 21, 1907

INDIAN TREES

Indian Trees Being an Account of Trees, Shrubs, Woody Climbers, Bamboos and Palms Indigenous or Commonly Cultivated in the British Empire By Sir Dietrich Brandis, K C I E, F R S Pp xxxiv+767 (London Archibald Constable and Co., Ltd, 1906) Price 16s net

SIR DIETRICH BRANDIS is much to be congratulated on the completion of this very important work on the forest trees and shrubs of British India, and its appearance will be hailed with great satisfaction by all Indian forest officers and by many others who are interested in the botany of that country

The chief value of this work consists in its comprehensiveness as a classified and descriptive list of all the different kinds of trees and shrubs of actual or possible value to the forester The inclusion of species belonging to the latter category is of importance, because, as the author remarks —

"Quite unexpectedly a shrub, a climber, a bamboo or a tree may be found to be of considerable importance from a forester's point of view, and he should then have easy means of identifying the species in question"

Moreover, the value or importance of many trees and shrubs is apt to vary very considerably in different parts of India The book will also, by reason of its comprehensiveness, be of great assistance as a basis for the preparation of local forest floras The "Forest Flora of North-West and Central India," which was commenced by the late Dr Lindsay Stewart in 1869 and completed by Sir Dietrich Brandis in 1874, has always been regarded as a model example of what a local forest flora should be If on this pattern a series of such works could now be undertaken for the more important forest regions in India, the utility of the present work would be realised in the process of their preparation, and the difficulties in the way of identifying trees and shrubs would be greatly lessened by reason of the limited number of species The literature of Indian forest botany is very considerable, but local forest floras, with the exception of Gamble's "List of Trees, Shrubs and Large Climbers of the Darjiling District," Kanjilal's "Forest Flora of the School Circle," and Talbot's "Systematic List of Trees, Shrubs, &c, of the Bombay Presidency," are more or less out of date

The number of trees and shrubs described in this volume amounts to more than 4400, the flora of Ceylon not being included As this list of woody plants represents about one-fourth only of the total number of flowering species known to occur within this area, some idea can be obtained of the extraordinary richness and variety of the vegetation of British India taken as a whole The following extract from Sir Joseph Hooker's most interesting "Sketch of the Flora of British India"[1] contains a brief and clear explanation of the manner in which the main characteristic features of the vegetation were brought about —

"The Flora of British India is more varied than that of any other country of equal area in the Eastern hemisphere, if not on the globe This is due to its geographical extension, embracing so many degrees of latitude, temperate and tropical, and to its surface rising from the level of the sea to heights above the limits of vegetation, to its climates varying from torrid to arctic, and from almost absolute aridity to a maximum of humidity, and to the immigration of plants from widely different bordering countries, notably of Chinese and Malayan on the east and south, of Oriental,[2] European, and African on the west, and of Tibetan and Siberian on the north"

Mr Gamble, in his "Manual of Indian Timbers," estimates the total number of trees and shrubs (including woody climbers), which constitute the forest vegetation of the whole of India and Ceylon, to be 4719 If to these were to be added the more or less established species introduced from other countries, and allowing for a certain number of shrubs and woody climbers which have not been included in the estimate, a total of 5000 species would probably be reached

Some interesting remarks will be found in the introduction to Sir Dietrich Brandis's book on the geographical distribution of forest trees in India, a subject which, by reason of his extensive journeys and practical knowledge of the country, he is fully qualified to deal with Other important topics are briefly alluded to, chiefly as being problems requiring further investigation, such, for example, as the anomalous wood-structure of some kinds of trees and woody climbers, the tendency of certain gregarious species of trees to form pure forests, the periodic flowering of some gregarious species of bamboo and Strobilanthes, &c, and another subject which has engaged the author's attention from time to time relates to the production of permanently dwarfed trees and shrubs by the action of periodical jungle fires

The facilities provided in this book for the identification of the species are —(1) The synopsis of natural orders on pp xxv to xxxii of the introduction As the determination of the natural order is very frequently the most difficult part of the operation in the attempt to identify an unknown plant, it would have been satisfactory if more assistance could have been given by means of keys for each of the larger groups of orders belonging to Thalamifloræ, Calycifloræ, Gamopetalæ, and Monochlamydeæ (2) The keys to genera and species are quite satisfactory, and will be very helpful, (3) the index to vernacular names on pp 723–736, and (4) the illustrations, which consist of 201 figures interspersed throughout the book, many of these are very excellent portraits, and cannot fail to be of assistance towards the identification of what they represent

The natural orders are arranged in accordance with the "Genera Plantarum" of Bentham and Hooker,

[1] See in descriptive volume of the "Indian Empire" in the new edition of the "Gazetteer of India".
[2] In the sense of Boissier's "Flora Orientalis."

with one important exception, viz that the Gymnosperms are placed after the Monocotyledons In regard to genera and species, the "Flora of British India" has for the most part been followed

The descriptions of the commoner and more important species are printed in large type, and the information regarding them is given in three separate paragraphs The botanical name, the references to other books, and the vernacular names occupy the first paragraph, the second contains the description, and in the third, printed in smaller type, will be found the distribution of the plant in and beyond India, the time of flowering, and other information The botanical descriptions occupying the second paragraph though sometimes rather brief, are very much to the point There is, however, a want of uniformity in the punctuation, which tends in many instances to prevent the essential points of the description from catching the eye The use of a different type for the names of the principal organs such as calyx, corolla, stamens, ovary, &c, would have answered the purpose to some extent

The order Dipterocarpaceæ, which contains some very important timber trees, and others which yield valuable oils and resins has been specially studied by the author[1] In this book he describes nine genera and thirty-seven species Of the large family of Leguminosæ, fifty-one genera are included The oaks number thirty-seven species, the majority of which are restricted to the eastern Himalaya, Burma, and the Malay Peninsula, only seven extend to the western Himalaya, and not one has been recorded from the western peninsula Of palms, twenty genera and eighty-nine species are described The bamboos, which constitute a distinct tribe of the large and important family of grasses, have been very carefully done, fourteen genera and 102 species are mentioned Of the Coniferæ, nine genera and twenty-one indigenous species are described

A serious drawback in the get-up of this book is its excessive weight Having decided to use such a very heavy paper, it might yet have been arranged to divide the book into two equal-sized volumes This would have made each volume so much more convenient for handling than is the present book

J I D

A HANDBOOK TO THE MICROSCOPE

The Principles of Microscopy, a Handbook to the Microscope By Sir A E Wright, F R S Pp xxii+250 (London Archibald Constable and Co, Ltd, 1906) Price 21s net

THE author of this book is a skilled pathologist, and, therefore, necessarily a practical master of the manipulation of a microscope, at least in the case of transparent objects He has probably arrived at his views on the microscope by prolonged and varied practice, and by independent thought, rather than by studying the work of others He thinks the reader may find a grievance in the number of newly-coined words which he employs, but in a special subject no one should object to technical terms, without which science would indeed involve circumlocution, so long as a new technical term is carefully defined

Sir A E Wright labours under heavy self-imposed difficulties He always seeks to avoid a mathematical sign, the use of which as a substitute for speech can be defended, he says, "only in the case of the inarticulate classes of the learned" He ignores the fact that speech, whether in sound or in black and white, is as much *sign* as mathematical expression is sign, and nothing like so accurate

The reader of the book may therefore profitably bear in mind that the work is an exposition of the author's own views and explanations of results which often are unquestionably true but sometimes admit of doubt

The book is full, very full indeed, of beautifully executed diagrams, but conclusions are rather hastily drawn from them, and the reader is often left to derive his proof from due consideration of them rather than from detailed explanation We can well understand that a beginner will not be quite satisfied, but we recommend him to persevere, as he will certainly find many practical rules as to the use of condensers in variously illuminating microscopic objects, and experiments illustrating these rules in a very complete way, plainly described and easily executed A small diffraction grating is supplied with the book

The first five chapters are devoted to the consideration of the object, its visibility, and the differentiation of its details as depending upon its preparation in mounting and staining, and upon its illumination The author strongly and reasonably urges the view that it is from this side of the microscopic problem that important new discoveries will spring, rather than from improvements in technical optics To differential staining he prophesies a valuable field of work in the future

The second part of the book treats, in what seems to us an original way, of the microscope itself and of the optical matters connected with it The author conceives the passage of light through a lens system as divided up into vistas composed of cones of light The object, a small one, is at the vertex of a cone the base of which is the aperture of the first lens encountered The second cone has the same base as the first, but its vertex is in the first image The vista is completed at the real image, even if two lenses are employed before its formation We thus have the opening limb and the closing limb, the pole of origin and the terminal pole, and the waist, of a vista, introduced as technical expressions One vista may succeed another, and we may have a *catena* of vistas Thus we may have a condenser vista starting with the source of light and terminating at the stage, an objective vista beginning at the stage and ending between the lenses of the Huyghenian eyepiece, and an eyepiece vista starting at the last-mentioned place and ending on the retina of the eye, forming a catena of three vistas

This plan has the advantage of representing

[1] See in Engler and Prantl 'Pflanzenf' vol iii, part vi, also in Journ Linn Soc, vol xxx, p 1

graphically many of the properties of a train of lenses, especially points of magnification and aperture, but it must be used discreetly The author has himself been betrayed into an erroneous conclusion by means of it If the origin of such a catena is a point of light, and a small opaque disc is inserted in the opening limb, the lane of darkness succeeding it will follow the same rules of formation as the cone of light, i e it will be a succession of cones having bases at the apertures and vertices at the images One base is the conical projection merely of the previous one Now Sir A F Wright is rather prone to overrate the resemblance between projections and images He calls the similitude of a candle shining through a small hole upon a screen an image That is not the sense in which the word is technically employed An image is always a focussed image, though the qualification is not invariably stated But the confusion of the two ideas leads the author into language which cannot be interpreted otherwise, we think, than as implying that every detail in one aperture, say a fleck of dust, is repeated as a genuinely focussed image situated at succeeding apertures It is only a projection that takes place in such a case, and it would occur equally well at any plane along the line, and when the source of light has finite dimensions, even this strictly defined projection will not occur This idea that everything in one aperture is *focussed* in succeeding apertures leads the author to more than one conclusion which, if we read him aright, is not sound

An example of error arising really from the neglect of the focussing idea occurs in the author's justification, for it is not a proof, of the expression for the numerical aperture, in so far as it increases with the index of refraction of the external medium In one of the diagrams (p 74) the final surface of a convex lens is drawn as a plane, and in that case the excentric ray of a convergent beam will not intersect the axis if it finds itself in water or in oil, at a point so close to the lens as if air were the medium in which it emerges That is true, but it is no proof or even illustration of the point under consideration, which is the effect of the index upon the numerical aperture This will be manifest by supposing the lens a convex meniscus with the second surface concave, and the origin of light to be at the point which is conjugate to the centre of curvature of the second surface Then the light, both immediately before and after encountering the final face, will be normal to it, and an emergent ray will intersect the axis at the same point whether the surrounding medium be air or water But the numerical aperture would still be affected by the medium

The aperture question seems, indeed, a stumbling-block to the author He knows as well as others do the connection between the radius of the false disc and the numerical aperture, and he rightly defines the latter, but his proof of the proposition at pp 110, 111, would make the numerical aperture proportional to the tangent (instead of the sine) of the semi-angle of the cone of light

The author has constructed an instrument to which he has given the name eikonometer, not a very happy one, for its object is, not to measure images generally, but by measuring certain images to arrive at magnifying powers The principle which is not so new as the author supposes, any more than the constructed instrument, is the fact that if two lenses are placed upon the same axis at any convenient distance apart, the first principal focus of one is conjugate to the second principal focus of the other, and the object bears to the image the same linear proportion which the focal lengths of the two lenses bear one to the other Hence, if the object be of known dimensions and its image be measured and therefore also known, and if one of the focal lengths be known, the other is also at once determinable The actual focal length of an entire microscope may thus be and has been determined in one observation The magnifying power is usually taken as the number resulting from the division of 250 by the focal length in millimetres but this is an arbitrary rule which presupposes that 250 millimetres is the least distance of distinct vision which is certainly not the case universally The author does not use the eikonometer quite logically In finding the focal length of a microscope his instruction is, *first* to focus the microscope in the usual way upon a scale of known dimensions situated on the stage, then to place the eikonometer over the eye end of the instrument and to read off

The instruction should be *first* to place the eikonometer in position, and *then* by means of the ordinary focussing arrangement of the microscope bring the image of the scale on the stage into position at the scale of the eikonometer, and then read off

The author thinks himself at issue with Abbe in the conclusion drawn from the grating experiment of the latter This arises through a misapprehension, and the experiments which the author cites do not affect the conclusions which Abbe reached

THOMAS H BLAKESLEY

THE CRUSTACEA OF DEVON AND CORNWALL

The Crustacea of Devon and Cornwall By Canon A M Norman, F R S, and Dr Thomas Scott Pp xv+232, 24 plates (London William Wesley and Son, 1906) Price 1l 4s net

STUDENTS of British carcinology owe their thanks to Dr Norman and Dr Scott for the first appearance of a volume embracing the wide field of our indigenous crustacean fauna, as hitherto recorded in the Devon and Cornwall area Dr Norman's researches in this district, extending over a period of more than fifty years, are too well known to need mention here, and the publication of his records is a welcome addition to our literature The introduction contains some interesting comparative tables on the distribution of species north and south relative to the area with which the work is concerned The body of the work comprises an enumer-

ation of the species, with synonymy and records of occurrence, and occasional descriptive notes, with twenty-four plates

The laborious task involved in gathering together the extant records of those who have in past years contributed to our knowledge of the British Crustacea must not be underestimated, but it is much to be regretted that the authors did not at the outset, in the compilation of such a work, bear in mind more fully the need of the student to whom, if not already an expert, a mere enumeration of our crustacean fauna can be of little assistance in his work We would much have wished that the authors, with their wide knowledge of the group, had seen well to combine with their work a system of synoptic tabulation, whereby the volume might have been made of more practical service to the student The portion dealing with the Copepoda bears witness to the extreme care bestowed on this part of the work Records of occurrence are given in interesting detail throughout, and the many new species for the discovery of which we are indebted to the authors are very fully described, their distinctive characters being well exhibited in the accompanying plates We would wish that the same careful system had been followed throughout the remainder of the volume, where records of observation are very bare and indefinite, rarely with dates, and distinctive characters are for the most part entirely omitted There seems, for example, no reason why two succeeding species of Galathea should be dismissed with the bare entry "common," or why, at the opening page, the three species of Ebalia should be passed over without comment, despite the precarious identity of one of them, which some of us still hope to retain

The retention of errors like "Daphina" (p 102), "Reptort" (p 185), and two authors' names, in a footnote to p 202, both of them mis-spelt, is a disfigurement to the text *Squalus galeus* and *S acanthias* (p 74) are inconsistent with *Galeus vulgaris* and *Acanthias vulgaris* elsewhere "Whiting-pout (*Gadus fuscus*)," on p 216, is misleading On p 192, for the host of *Asterocheres suberitis* the name *Suberites domuncula* is employed, a sponge which, properly named, does not, so far as we know at present, exist in our fauna

Including eighty-six inland forms, 808 species of Crustacea are recorded for the area concerned, the marine Copepoda and Amphipoda numbering 274 and 142 respectively As compared with these figures, Dr Scott has previously recorded for the Clyde district 855 species, the Sympoda, Amphipoda, and Ostracoda being responsible for the difference

While feeling a certain sense of disappointment at the general scheme of the work, we are much indebted to the authors for placing at our disposal a valuable record of observation which it is hoped may some day contribute largely to the drawing up of that much-needed work, a handbook to the British Crustacea

L R C

PALÆONTOLOGY FOR STUDENTS.

Die Leitfossilien aus dem Pflanzen- und Thierreich in systematischer Anordnung By Dr Johannes Felix Pp x+240, illustrated (Leipzig Veit and Co, 1906) Price 6 marks

SINCE the publication of the late Prof Karl von Zittel's exhaustive "Handbook of Palæontology," several smaller books have been compiled on the same plan The encyclopædic method, which is appropriate enough for a large work of reference, has been adopted in the less pretentious text-books for the use of elementary students who desire only a general acquaintance with fossils The result is that instead of teaching fundamental principles and broad outlines, these little books provide an overwhelming series of disconnected facts which weary the memory, and palæontology is not only discredited as a mental exercise, but also becomes unpopular with those who really need its guidance while pursuing allied branches of science

Another of these small books has just been laboriously compiled, with numerous illustrative figures, by Dr Johannes Felix, the well-known palæontologist of Leipzig It is neither better nor worse than its predecessors, and illustrates well the disadvantages of the dictionary form for elementary teaching For instance, among Carboniferous plants, one of the most important groups is that of the Pteridosperms, bearing well-developed seeds in association with fern-like foliage Dr Felix's brief catalogue may enable a student to distinguish a Neuropteris from a Pecopteris, and so forth, but it does not give the least clue to the real interest or meaning of these fossils Again, among vertebrate animals, the theromorphous reptiles are of fundamental value is pointing out the direction in which the cold-blooded land animals passed into the warm-blooded mammals The book before us, though pretending to deal with fossils at varying lengths according to their degree of importance, does not even mention that the Theromorphs were chiefly land animals It merely catalogues, with a desultory statement, the skull of the sea-reptile Placodus, which is probably not a Theromorph at all, and certainly gives no conception of the nature of the group in question

Still worse, this compilation and condensation of matter from previous text-books destroys all effort to bring the subject up to date It is much simpler to select a few miscellaneous facts from an exhaustive collection, and to purchase a set of electrotypes in a wholesale manner, than to make a judicious use of original memoirs and prepare new drawings to illustrate the science as it is now understood We therefore look in vain among the "Leitfossilien" enumerated by Dr Felix for any allusion to the European Lower Palæozoic fishes, the South African Triassic reptiles, the Egyptian Tertiary mammals, and the remarkable discoveries in South America, which have revolutionised many ideas in palæontology during the past two decades Students may be able to name a few common European fossils if they happen to have

the patience to pore over this new book, but they will not gain much insight into the science these fossils illustrate, and their enthusiasm must be unusual if they retain any desire to proceed with palaeontological research when they have completed their course A S W

THREE ASPECTS OF ELECTRICAL ENGINEERING

Applied Electricity a Text-book of Electrical Engineering for Second Year Students By J Paley Yorke Pp xii+420 (London Edward Arnold, 1906) Price 7s 6d

The Electrician Primers Edited by W R Cooper Three volumes in one Vol i, Nos 1-24, Theory Vol ii, Nos 25-55, Traction, Lighting and Power Vol iii, Nos 56-80 Telegraphy, Telephony, Electrolysis and Miscellaneous Applications (London *The Electrician* Printing and Publishing Co, n d) Price 10s 6d net

Electricity of To-day its Work and Mysteries described in Non-technical Language By Charles R Gibson Pp xiv+347 (London Seeley and Co, 1907) Price 5s net

THE three books before us suggest an interesting comparison of three points of view from which any applied science can be regarded Each covers, or attempts to cover, in a more or less summary fashion, practically the whole subject of electrical engineering, but as each appeals to an entirely different audience, the difference in method of treatment is necessarily very marked Mr Yorke's volume is written for the student who proposes to become an electrical engineer, the genuine professional, whose chief assets must be knowledge and brains The readers of the *Electrician* Primers will mostly be found amongst artisans, amongst the class not unjustly distinguished from electrical engineers by the name of electricians, people who require a fair amount of knowledge, but who can get on with a very limited amount of understanding Finally, Mr Gibson's book makes its appeal directly to the general public, or to that section of it which shows an intelligent desire to keep abreast of the times and is not content to utilise the advantages of civilisation without some attempt at appreciating the manner in which they are obtained

The great necessity for the professional engineer in his college training is to obtain a sound foundation on which to build by means of future experience Facts are easily learnt and as easily forgotten, whilst even if remembered they are likely to prove of but trifling value in actual practice No man can say when he is at college what branch of his profession is going to occupy his future, and it should be the aim, therefore, of any second year's course to impart a sound knowledge of the way in which the fundamental physical principles of electricity and magnetism are utilised in the practical applications of electrical engineering Mr Yorke has kept this point of view clearly before him in the book under review, and has succeeded on the whole very well in elucidating the connection between theory and practice There is no question, however, but that the value of a book of this kind depends almost entirely on the lectures and laboratory work that accompany it Text-books alone are so incapable of giving sound instruction in electrical engineering that one is almost justified in maintaining that to criticise them apart from the course with which they are to be used is idle The best that can be said is that the book would serve as a very useful model on which to base a second year's course of instruction It is perhaps, unwise that manufacturing methods should be described, in one or two instances this has led to mistakes which might have been avoided

To attempt a detailed criticism of the *Electrician* Primers would be to write a volume as bulky as that which they themselves form They range over such diversified subjects as "Curves and their Use," "Electric Railways," and "Photo engraving," to quote but a few examples Each primer forms a small handbook, and the artisan engaged in any particular branch of work would gain a fair insight into the *raison d'être* of his various operations by the study of those primers dealing specially therewith As a reference book also the complete set should prove useful The electrician occupied with tramways may occasionally find it necessary to know something about arc lamps or telephones, and in such cases the rough general information he requires could probably be obtained from these primers The whole ground of electrical engineering is covered very completely by the series

The correct person to review Mr Gibson's book is a member of the general public and not an electrical engineer, as the principal questions to be answered are, Is it intelligible? and Is it interesting?

It is a hard task to describe some of the more complicated developments of electrical engineering in simple, non-technical language, and to avoid incorrectness in the search for simplicity Mr Gibson has, however, accomplished this task with remarkable skill, and for many passages deserves to be sincerely congratulated There is too great a tendency, perhaps, to the relation of amusing little anecdotes which do not teach much, and to what may be described as sensationalism, but this is very natural and perhaps excusable The interest of the layman, no doubt, requires to be sustained by such illustrations as the photograph of a church wrecked by lightning, or of an attractive young lady making afternoon tea with an electric kettle But neither of these pictures has much educational value To cavil is, however, ungracious, the more the public can be interested in electricity the better for the whole trade and profession, and Mr Gibson's book will undoubtedly help on the work of progress One is apt to laugh at "popular" science, but Mr Yorke's students and the *Electrician's* artisans would all be amongst the unemployed without the market which Mr Gibson helps to provide MAURICE SOLOMON

OUR BOOK SHELF

Penrose's Pictorial Annual. The Process Year Book for 1906–7. Edited by William Gamble. (London: A. W. Penrose and Co., Ltd., n.d.)

THIS valuable and beautifully got-up volume surpasses, if possible, its predecessors. In the last few years the colour process has been rapidly coming to the front, and the present issue of this annual gives the reader an excellent insight into the good quality of the results which may be secured by the best processes of the day. The editor's task has evidently been no light one to include in this volume the wealth of material that is available, but the reader will be more than satisfied when he peruses it himself.

The arrangement of the book is the same as in former years. A most interesting series of articles dealing with process work and allied subjects is contributed, and the names of the authors are a sufficient guarantee for them. Thus, to mention only one or two cases, the editor gives a brief but clear account of the recent progress in process work, while Major-General Waterhouse describes the work of M. Léon Vidal, who, as he says, was a man who "fully recognised the educational value of photography," and who did much for its development, especially in the direction of photomechanical work, and the practical application of permanent printing processes for book illustration. M. Vidal's last contribution to this annual is contained in the present volume, and is entitled "The Future of Colour Photography when Autochrome Plates come into General Use."

Turning from the text to the illustrations, we have here also much food for thought. The frontispiece is an admirable engraving of Charles I. by the Rembrandt Intaglio Printing Co., Ltd. Of the numerous three- or four-coloured illustrations, mention may be made of those opposite p. 8, entitled "Still Life," by Messrs. John Swain and Son, Ltd., opposite p. 128, entitled "Dessert," by Messrs. H. Kollien and Co., and following p. 136, entitled "Mimosa Blossom," by Messrs. Hood and Co., Ltd.

Einführung in die mikroskopische Analyse der Drogenpulver. By Dr. L. Koch. Pp. viii+174. (Berlin: Gebrüder Borntraeger, 1906.) Price 4 marks.

THE microscopical examination of drugs for the purpose of gaining an accurate knowledge of their constitution and of learning to detect impurities and adulterations is now recognised as a necessary part of the usual courses for pharmaceutical students, and as many chemists endeavour to acquire part of their knowledge during the term of their apprenticeship, they require books of this nature to help them in their independent studies.

Dr. Koch has prepared this elementary manual as an introduction to the specialised vegetable histology that affords the principal means of distinguishing pharmaceutical products with the aid of the microscope. A few examples of well-known drugs selected as specimens of bark, seed, and other plant products are described in detail, and the elements are figured. The instructions are so minute and thorough that a student using the book intelligently should soon become proficient in histological determination. The chapter on methods is not, however, so complete as would be expected. Although powdered preparations are generally used for investigations, it is at least desirable that the student in his training should become efficient in section cutting. Further, a more extensive account of reagents would be helpful, for while agreeing with the substitution of chloral hydrate in place of potash, there seems no reason for leaving out potash altogether, or sulphuric acid and several other recognised testing solutions.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

An Occurrence of Helium in the Absence of Radio-activity.

I MENTIONED in NATURE a few weeks ago (January 17, p. 271) that I was engaged in examining the inert gases contained in ordinary (inactive) minerals. A result has been obtained so surprising that it seems worthy of immediate record. I have found that beryl contains a quantity of helium of quite a different order of magnitude from what is found in ordinary inactive minerals. Thus 250 grams of beryl from New Hampshire gave 4·2 c.c. of helium on heating. The mineral appears to be absolutely without radio-activity. A tray of the powder, placed in the case of an electroscope of exceptionally small natural leak, did not increase that leak to any measurable extent.

It seems likely that we have here a case of rayless change. In all probability beryllium is the constituent of beryl which is concerned. It is hoped to test this view further by the comparison of different minerals.

R. J. STRUTT.

Sunnyside, Cambridge, February 19.

The Rusting of Iron.

SEVERAL letters have appeared in NATURE respecting the conditions under which iron rusts. The usually accepted view has been that iron will not rust unless carbonic acid is present. After a very careful investigation of the subject I was led to the conclusion that provided iron, oxygen, and liquid water are brought together, chemical change takes place with the production of rust even when every precaution has been taken to exclude even traces of carbonic acid, and that therefore some other explanation must be found for the fact that alkalis inhibit the rusting of iron. An explanation has also to be found for the fact, established in the course of this investigation, that if polished iron is immersed in a solution of potassium dichromate rusting is completely inhibited, and the surface of the metal remains perfectly bright (Dunstan, Jowett, and Goulding, Journ. Chem. Soc., 1905).

Dr. Gerald T. Moody has recently given (Journ. Chem. Soc., 1906) an account of experiments he has made from which he concludes that carbonic acid is essential to the rusting of iron, and that rusting does not occur in its absence.

As these experiments were made under somewhat different conditions from mine, they have been repeated. The results obtained are, however, not confirmatory of the conclusion that carbonic acid is essential to the rusting of iron.

This apparently simple chemical change requires additional experimental study, and I hope shortly to be able to make some further contribution to the subject.

February 19. WYNDHAM R. DUNSTAN.

Ionisation and Anomalous Dispersion.

THE experiment recently described in a letter in NATURE by Dr. Schott (January 17, p. 271) does not appear to me to have any very direct bearing upon ionisation. There appears to be no question but that the changes observed in the dispersion curve were due to an alteration in the optical density gradient of the sodium vapour, resulting from local heating by the wire. The experiment is very similar to one which I made two years or more ago, during an examination of the physical properties of the vapour. A wire was stretched through the tube, along its axis, and heated by a current. The vapour was observed to be much less dense around the heated wire. The observations were made by looking through the tube either at a sodium flame or a lamp behind bluish-green glass (for which light the vapour was very opaque). On heating the wire a clear space appeared around it. If I remember rightly, I never published this result, as the experiment was one of a series which has not, even yet, been completed.

In a sodium dispersion tube the density of the vapour

is very great along the floor, immediately above the surface of the molten metal, falling off very rapidly as the roof of the tube is approached It has always appeared to me probable that we are dealing with clusters of molecules, though there may be some simpler way of explaining the very steep density gradient At all events, local heating of the denser portion of the vapour reduces its density, it seems to me, to a much greater degree than would be the case with an ordinary gas The steep density gradient only occurs when the top of the horizontal tube is cooler than the floor, that is, cool enough to condense the vapour The tubes I usually exhaust to a pressure of a millimetre or two, and I have always found it difficult to explain how it is possible to have a layer of vapour along the floor so dense that it is deep violet in colour, while along the roof the vapour shows no trace of colour at all On the kinetic theory, it seems to me that we should expect the vapour to be moving rapidly from the floor to the roof, without, however, showing much difference in density at different points It may be however, that the traces of hydrogen which are present may be the cause of the phenomenon What we call "very dense sodium vapour" along the floor of the tube may be pure sodium vapour at a pressure of only a couple of millimetres Along the roof we may have nearly pure hydrogen at the same pressure, and at intermediate points mixtures of the two in varying proportion, the sodium working its way up through the hydrogen and condensing on the roof It will be well to try a very highly exhausted tube

Upon the whole, I think perhaps this is the most conservative way of looking at the thing, though my impression is that the hot wire produces a greater reduction of density than we should expect on this assumption

Baltimore, February 5 R W WOOD

A New Chemical Test for Strength in Wheat Flour

THAT different wheats make flours of very different baking values has been known for a long time, and is emphasised by the fact that English millers are at the present time paying several shillings per quarter more for certain foreign wheats than for home grown wheat

Baking value, or strength as the millers and bakers call it, is a subject of much interest, and many workers have tried to connect it with some definite physical or chemical property of the grain or flour Thus it has been stated to depend on the percentage of gluten, the percentage of gliadin or the ratio of gliadin to gluten

None of these explanations has been found to meet all cases, nor is there any likelihood of finding any single factor which is capable of measuring so composite an idea as strength as understood by the miller or baker

The value of a flour to the baker depends on at least four distinct properties —(1) the volume of the loaf a given quantity will produce, which may vary more than 30 per cent, (2) the amount of water which a given quantity will absorb in making a dough of proper consistency for baking, which may vary from one-half to three-quarters of its own weight (3) the shape of the loaf, and (4) such points as texture and colour of the bread

The baker, and apparently most of those who have attacked the problem, have confused these widely divergent properties under the single name of strength, and attempted to find one chemical or physical factor which will measure them all at once

In taking up this subject it seemed to me that the most hopeful line was to treat each property as a separate problem, and as the question of size of loaf seemed simplest, I have for the most part confined my attention to that aspect of the investigation

In converting a given amount of flour into a loaf of bread, the flour is mixed with water and yeast, and allowed to ferment for some time It is then put into the oven and baked The yeast finds sugar in the flour, feeds on this, and converts it into alcohol and carbon dioxide, and the volume of the loaf must depend either on the volume of carbon dioxide evolved, or on the power of the flour to hold this gas

To test this a number of flours were obtained from Mr A E Humphries chairman of the Millers' Association, who had kindly tested them in the bakehouse, and determined their strength The scale of strength adopted is a purely arbitrary one The mark 100 is assigned to the best flour on the market and 0 to a flour which is quite unbakeable

In each experiment 20 grams of flour were mixed with 20 c c of water and half a gram of standard yeast incubated at 35° C, and the carbon dioxide liberated directly measured The results are appended —

Reference No	Baking value or strength	CO_2 evolved cc
1	96	270
2	90	325
3	73	274
4	68	227
5	65	205
6	45	156
7	36	131
8	20	287

It will be seen that with the exception of Nos 1 and 8 the order of strength and of carbon dioxide evolved are the same Perhaps the greatest confirmation of the idea that strength is directly dependent upon the capacity of a flour for acting as yeast food is found in the apparent exceptions On inquiry from Mr Humphries, I learned that the high mark assigned to flour No 1 was based upon bakings made after the addition of malt extract, while the low value given to No 8 was based on baking tests made some months earlier The high carbon dioxide value actually found for the latter enabled me to predict that the flour must have changed in composition so as to have gained in strength and this prediction was verified On baking again it was marked 40 with the report that it made a large loaf and would have been marked higher but for the bad shape

The quantity of carbon dioxide given off by a dough will depend upon two things—the sugar present is such in the flour, and the diastatic capacity Analysis showed that in the flours experimented with the sugar present varied from 2 56 per cent in the strongest to 1 60 per cent in the weakest, and followed very closely the order of strength throughout the series Diastatic capacity has not yet been thoroughly examined

The addition of sugar to flour was found always to increase the volume, the weight, and the height of the loaf In a typical experiment made with household flour the increases were as follows volume, 15 per cent weight 2 per cent, and height 30 per cent

These experiments seem to prove conclusively that the volume of the loaf depends in the first instance upon the amount of sugar available in the dough, and a ready test is thus provided for that aspect of strength which is concerned with the size of the loaf The other factors included in strength are at present under investigation

T B WOOD

Department of Agriculture Cambridge

The Flight of an Elongated Shot

WITHIN the limits of accuracy of this discussion it may be assumed that the sections of the shot normal to its axis of figure are circular, that its C G is in the axis of figure, and that this axis and all the diameters of the circular section at the C G give the directions of the principal axes of inertia at the C G Angular momenta will be referred to the C G, the axis of the shot will be called simply the axis and all directions will be understood as viewed from behind the shot

The chief disturbing forces are the normal pressures of the air the frictional forces being of a secondary order of magnitude These normal pressures will be at a maximum upon the ogival head of the shot The areas of such relatively smaller pressures as are due to vortex motion in the air, and to the partial vacua set up behind advancing surfaces directly presented to and against the air will be situated towards the base of the shot, and upon the upper or the lower side of the shot according as the axis is pointed above or below the tangent to the path of the C G, i e the tangent to the trajectory

Now, from the first moment of the free motion the tangent to the trajectory falls away more and more from the axis of the shot The immediate result of this is the

setting up of an area of maximum pressure upon the underside of the ogival head This gives rise to a resultant disturbing couple, which, by reason of the symmetry of the surface, has its axis parallel to the horizontal principal axis at the C G, and this axis is directed rightwards Since this disturbing couple has its axis at right angles to the axis of angular momentum, i e to the axis of figure, it causes a precessional motion of the axis in the plane of its own axis and of the axis of figure, so that this axis begins to turn itself slightly to the right of the trajectory, the rifling being taken to be right-handed This action is a very small one, because the couple producing it is very small compared with the couple which is equivalent to the total angular momentum The axes of angular momentum and of angular velocity being initially coincident with the axis of figure, while the axis of the disturbing couple is at right angles to it and parallel to one of the principal axes at the C G, this couple has no effect upon the magnitude of either the angular momentum or the rotational velocity It alters only the orientation of the axis of angular momentum and leaves it coincident with the axis of figure

Now this deflection of the axis to the right causes the left side of the head of the shot to experience a greater normal pressure than the right, and so gives rise to a second disturbing couple of small magnitude relatively to the whole angular momentum, about an axis parallel to a principal axis at the C G and directed downwards very nearly if not exactly, in the vertical plane through the axis of the shot The effect of this is to bring about a precessional motion of the axis in this plane directed downwards, so that the nose of the shot begins to dip towards the tangent to the trajectory This couple has, otherwise exactly the same effects on the motion of the axis as the other one and since both couples are very small in comparison with the total angular momentum it is permissible to combine their effects after considering them separately It thus appears that the axis acquires a small precessional motion about the tangent to the trajectory, and that the excess of pressure upon the left of the head will cause the trajectory itself to be bent to the right bringing about the well-known rightward drift of the shot If the rifling be left-handed the shot will drift to the left, but the nose of the shot will, as before, dip towards the trajectory

Any device that throws the C G well towards the base of the shot will have the effect of adding to the magnitude of the first of the above two couples A smaller deviation of the axis from the trajectory will then afford a larger disturbing couple and the rightward precessional motion will be more quickly established In consequence of this the rightward drift will be diminished A long, hollow bullet of thin steel, the rear half having a smaller diameter than the front half and this rear half being filled with lead, and also coated exteriorly with lead so as to take the rifling, may, on this theory, be expected to have less drift than the ordinary bullet, whereas a bullet weighted towards the head would have more

J W SHARPE

Woodroffe Bournemouth

The Problem of the Random Path

THE following illustration of Prof Karl Pearson's "Random Path" problem may be of interest

Mr Kipling in his story "The Strange Ride of Morrowbie Jukes," gives the following directions for finding the safe path across a quicksand, which directions are supposed to have been found by the hero of the story in the coat of an earlier victim —

"Four out from crow-clump, three left, nine out, two right, three back two left, fourteen out two left, seven out, one left, nine back, two right six back, four right, seven back"

These numbers were probably taken at random, and it will be noted that seventy five paces are taken and the final position is only seven paces from the original position

This is a rather curious confirmation of Lord Rayleigh's solution of the problem

REGINALD A FESSENDEN

SPEECH CURVES[1]

DR SCRIPTURE since 1901 has worked with zeal and energy at experimental phonetics, and he has published several valuable papers, as well as a large volume treating generally of the subject. The work has been carried on with the aid of the Carnegie Institution of Washington at Yale, Munich, Berlin, and Zurich It has been an expensive research, as in addition to costly apparatus a staff of clerks was required for computation A perusal of this monograph proves that Dr Scripture has shown great ingenuity in the construction of recorders and in overcoming technical difficulties that can be fully appreciated only by those who have made excursions into this field of research His experimental method has been to transcribe on smoked paper the curves of speech both from the gramophone of Berliner and the phonograph of Edison

On the disc of the gramophone the curves produced by sound vibrations are not indentations in the bottom of a groove or furrow, as in the tracing on a phonograph cylinder, but they are horizontal, as if they were drawn on the plane of a sheet of paper Further, it is interesting to note that in the gramophone record the depth of the groove is constant, whereas in that of the phonograph the downward movement of the recording disc bearing the cutting tool is diminished, in consequence of increasing resistance, in comparison with the upward movement Each instrument has its own peculiar quality of tone and, except in very fine modern instruments, natural sounds are more or less falsified This falsification Dr Scripture shows is due to a distortion of the waves by the bending of the diaphragm, and not to nodal vibrations such as occur on Chladni's plates His best tracings were taken from gramophone records by using either a simple or a compound lever, which at one end travelled slowly over the record, and at the other recorded the waves on a moving strip of smoked paper

There is no special novelty in this method except that it has been applied to the gramophone, and that the mechanical arrangements have been of the finest quality It gives one a notion of the delicacy of the method when it is stated that 1 mm of the tracing = 0 0004 sec The vertical magnification by the use of a simple lever was 300 times, but Dr Scripture adds —"The future of the method lies in the development of a compound lever" Great care was taken to identify any portion of the record on the smoked paper with the corresponding part of the surface of the gramophone plate This was accomplished by a very ingenious device The reproduction of the curves for printing was done by etching on zinc An example of a tracing of the sounds of an orchestra is shown in Fig 1, and the following is Dr Scripture's description —

"The curve in Fig 32 [Fig 1] is from the record of a note from an orchestra The most prominent vibration is one whose wave-length is 3 mm = 0 0012 sec, that is, about the note $g^2\sharp$ Another prominent feature is the grouping of these vibrations in threes, indicating a tone with a period of 9 mm = 0 0036 sec, or a note about $d^1\sharp$. There is one which reinforces every sixth vibration of the high note and another that coincides approximately with every ninth, the former would correspond to $c^0\sharp$, the latter to $g^{-2}\sharp$ The combination of all these notes—each comprising a fundamental with overtones—produces a very complicated curve From such vibrations, however, the ear can pick out not only the component notes, but also the characteristic tones of the piano, violin, &c" (p 33)

1 "Researches in Experimental Phonetics the Study of Speech Curves By Dr E W Scripture Pp 204 (Washington, D C Published by the Carnegie Institute of Washington, 1906)

In a similar manner Dr. Scripture gives a careful description of a large number of tracings of noises, whistling, various musical instruments, and human speech.

We now approach the most difficult part of the investigation, namely, the analysis of the curves produced by human speech. Dr. Scripture's plan has been to analyse carefully portions of actual speeches,

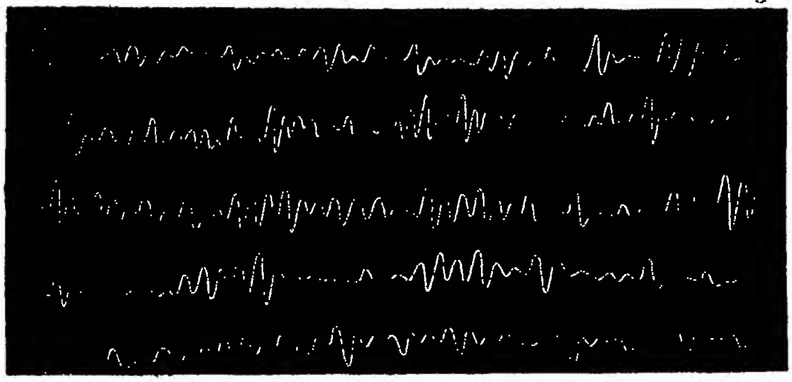


FIG. 1.—Record of a note from an orchestra.

as, for example, that of Chauncey M. Depew on "Forefather's day," when he says "Without regard to race or creed I can" &c., or from "Cock Robin," "With my little eye I saw him die" &c., or Joseph Jefferson's speech in proposing Rip Van Winkle's toast, "Come, Rip, what do you say to a glass? That's fine schnapps." As an example, take a small portion of the latter speech:—

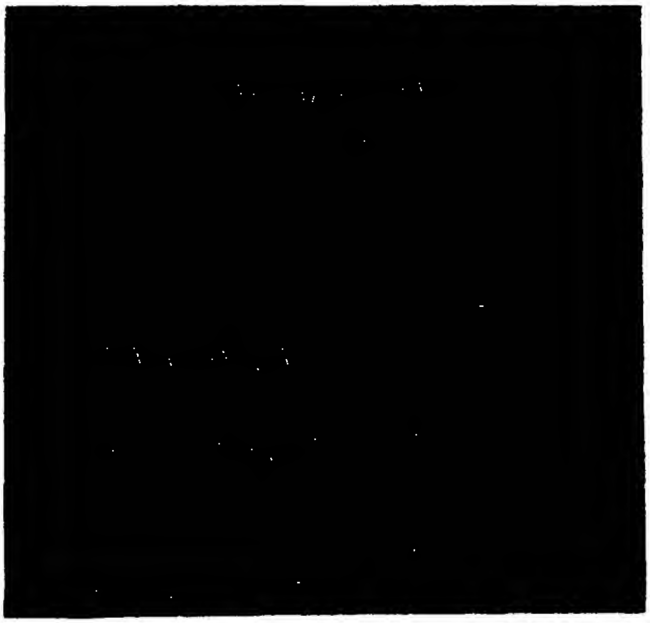


FIG. 2.—Curves showing waves from various vowels spoken by Joseph Jefferson in "Rip Van Winkle's Toast."

Each line contains only a few waves out of the curve for a vowel, and Dr. Scripture gives a careful analysis. It would have been better, I think, if Dr. Scripture, with his fine appliances, had given us an exhaustive examination of each vowel, not as it occurs in such a speech as we are considering, but by itself. The vowels here examined are "American vowels." Would it not have been better to have obtained first-rate gramophone records of clearly sounded vowels, and then to have reproduced the curves of these sounds? However, there can be no doubt Dr. Scripture's analysis teaches us a great deal. One would have expected that the wave forms in a vowel tone would have had the same form or shape for a short time, but it would appear that this is not so.

"So much has been said," writes Dr. Scripture, "of the complexity and the variability of the speech curves that the impression may have been produced that they are hopelessly irregular. This is not true. They are as irregular as the leaves of a tree; no two are alike, yet the individuals of a variety resemble one another, and differ from other varieties" (p. 49).

"As already pointed out, no two waves of a vowel are alike; the differences are often so great that we may be sure that one part sounds utterly different from another although the ear apparently gets only a single general impression" (p. 53).

Dr. Scripture then devised a method "whereby the ear can be enabled to hear the sound of each wave separately." A special apparatus was constructed by which a single selected wave was many times repeated on a strip of zinc, then etched, and then transferred to the gramophone disc. The group of waves reproduced the sound represented by these exactly similar waves, and the ear was appealed to as to the resemblance of the sound to any particular vowel. This is quite a novel method of investigation, and suggests further experimental work. It shows the possibility of transferring any set of curves to a gramophone plate and then listening to the sound and comparing it with other sounds. The writer of this notice, by another method, has obtained many curves of vowels, and he cannot altogether bear out the statement of Dr. Scripture that all the waves differ from each other. At the beginning of a vowel tone, and towards its close, the waves may differ, although of the same general type, but in the middle of the tracing, when the vowel tone is clear and distinct to the ear, the waves appear to be the same in form.

In the analysis of speech curves, Dr. Scripture attaches importance to what may be termed the melody of speech. We have "melody" when sounds of different pitch are heard after one another.

"The study of melody is the study of the fluctuations of the pitch of the tone from the glottal lips. Each explosion puff, or vibration from the glottis arouses a vibrating movement that shows itself in the speech curve as a group of vibrations; this we have called a 'wave group' or a 'wave.' A 'wave' thus means the whole complicated group of vibrations resulting from a single glottal movement. The study of melody has to do with these waves or wave-groups."

By a special method Dr Scripture plots a melody curve from a transcribed record, showing, for example, the curve when "Oh" is uttered "sorrowfully" or "admiringly," or "questioningly," &c He works out the "melody curves" in Depew's speech, and then writes the melody in musical notation With regard to the emphasis of speech as indicating the emotional condition of the speaker's mind, we must, however, take into account not only melody, or the sequence of tones of different pitch, but also the intensity, the passing from *diminuendo* to *crescendo*, or *vice versa* Dr Scripture has not attributed sufficient importance to this element in the analysis The amplitudes of the wave forms increase or diminish according to the intensity

Dr Scripture expounds the principles of harmonic and inharmonic analysis in two chapters at great length and with much clearness Nowhere have I met with a fuller exposition of Fourier's theorem and its application to acoustical problems He does not hold, however, that a vowel curve is produced by combining simple sinusoid vibrations in a harmonic series, and he concludes that

"the sounds from the musical instruments are presumably produced in this way but we dare not assume that the vowels are so produced until the fact has been proven" (p 78)

He shows how to separate, by the rules of Hermann harmonic and inharmonic sinusoids from the mixed results of a harmonic analysis How is one vowel distinguished from another? Are the differences due to the presence of certain tones of definite pitch, as held by both Helmholtz and Hermann? If so are we to hold with Helmholtz that these tones are harmonic overtones of the glottal tone or that they are inharmonic to it, as stated by Hermann? Dr Scripture holds that Hermann has completely disproved the theory of Helmholtz After discussing the method of analysis with frictional sinusoids, as distinguished from simple sinusoids, he states —

"The vibrations of the voice in speech are composed exclusively of frictional sinusoids and not of simple sinusoids, as has hitherto been assumed Can a method of analysis into frictional sinusoids be found? Does an analysis into simple sinusoids give false results for the vowel curves?" (p 101)

He answers the question thus

"The treatment of the curves by simple harmonic analysis the only method that has hitherto been tried—furnishes results that are so wrong as to be utterly misleading when used to indicate the manner in which the vibrations were produced"

I observe that Dr Scripture states that Prof Weber of the Swiss Polytechnicum, along with Schneebeli was the first to apply the Fourierian analysis to a vowel curve, but he does not give the date when this was done We must not forget that such an analysis was made by Fleeming Jenkin and Ewing in 1878 ("On the Harmonic Analysis of certain Vowel Sounds" *Trans Roy Soc Edin* vol xxviii p 745)

As to the mode of production of vowel tones, Dr Scripture discards the views of Wheatstone, Grassmann, and Helmholtz that the glottal lips vibrate after the manner of strings or the borders of a membrane on each side of a narrow opening, and he fully adopts the "puff" theory of Willis and Hermann, according to which

"the glottis emits a series of more or less sharp puffs, each puff, striking a vocal cavity, produces a vibration whose period is that of the cavity, a single wave group shows the sum of these vibrations from all the cavities, the periods of these vibrations may stand in any relation to the interval at which the puffs come, that is to the fundamental"

There can be little doubt that, at all events in his later days, Helmholtz saw the analogy between the action of the glottis and the "puffing" sounds of a syren, but he undoubtedly held that the overtones were harmonics of the glottal tone Hermann, however, has conclusively shown that at least some of the tones of the cavities may be inharmonic to the glottal tone, and Dr Scripture supports this view by many ingenious experiments His description, however, of the glottis is not either anatomically or physiologically quite satisfactory It is not in accordance with anatomical detail to write, "Each glottal lip consists mainly of a mass of muscle supported at the ends and along the lateral side," or that "the two masses of muscle close the air passage," or that the air from the trachea "bursts the muscles apart" The glottis is a much more delicate structure than these words would imply It contains much elastic tissue at the borders which come together, according to the "puff" theory, and the muscular structures are devoted to placing strains on this tissue and to separating or approximating the lips of the glottis Dr Scripture's view is that

"the effect of each puff on each element of the vocal cavity is double first to arouse in it a vibration of a period depending on the cavity, second, to force on it a vibration of the same period as that of the set of puffs"

The glottal puff produces a frictional sinusoid with large amplitude and a very large coefficient of friction, and the cavity vibrations are also of the frictional sinusoid form This may explain the failure of a simple harmonic analysis to reveal the real elements of the vowel curve

In chapter ix Dr Scripture gives his views as to the action of the organ of Corti in relation to wave analysis, and he conjectures that portions of it are affected by "groups of stimuli," when complex wave forms reach it This does not seem very conclusive, and in my judgment the theory of Helmholtz, by which he explained the action of the organ by adopting the principle of resonance, still holds the field

Dr Scripture has also attempted a synthesis of vibrations by ingenious mechanisms, by which he obtained curves somewhat similar to speech curves There is no doubt a great future for this line of experimental research After fully worked out examples of vowel analysis, with all arithmetical details, Dr Scripture appends to the end of the monograph a number of elaborate schedules to assist in the Fourierian analysis, namely, schedules of 12 ordinates, 24 ordinates, 36 ordinates, and 72 ordinates The preparation of these schedules was a very laborious task, and the work will be much appreciated

We congratulate Dr Scripture on the production of a splendid monograph It might have been improved by fuller bibliographical details, and perhaps by a more adequate recognition of the work of others

JOHN G MCKENDRICK

AGRICULTURAL EDUCATION AND RESEARCH [1]

ONE of the functions of the Board of Agriculture is the administration of a Treasury grant for the purposes of agricultural education, and though the total distributed is not large it has been a potent factor in stimulating the development of the higher forms of agricultural education during the last fifteen years It is certain that many of the county councils

[1] The Annual Report of the Board of Agriculture and Fisheries on the Distribution of Grants for Agricultural Education and Research in the Year 1905-6

which now help to maintain colleges giving instruction of a university standard would have never started at all or would have rested content with something in the nature of a farm school had it not been for the advice and practical encouragement provided by the Board of Agriculture.

During the past year we see that seven institutions were in receipt of an annual grant of 1000*l*., 200*l*. of which was in respect of the farm maintained by the college, while twelve other institutions received sums ranging from 800*l*. down to 100*l*. The University College of North Wales at Bangor and the Armstrong College at Newcastle each received a further 250*l*. for instruction in forestry. It is noticeable that the Board seems to make the amount of its grant depend upon the type of education given, not taking into account the number of the students educated or the extent of local support. Thus Wye College, the total expenditure of which is set at 17,414*l*., receives the same grant, 1000*l*., as other colleges the total expenditure of which does not reach 3000*l*. Probably this policy is most adapted to the pioneer work, when it is all important to get the colleges started, but the time is drawing near when some of the colleges supported most liberally by their localities must feel that they should be treated on the principle of the Treasury grants to university colleges, which are given roughly in proportion to the local support received.

In the body of the report nearly all the collegiate centres have the same tale to tell of an increase in the number of students, and that greater use is being made of the college by the farmers in the district. It is not too much to say that the attitude of the general body of farmers towards scientific work has entirely changed during the last ten or twelve years, wherever they have been within the range of influence of one of these permanent centres of instruction. The supply of agricultural intelligence certainly preceded the demand, but now the demand has more than grown up to the supply.

The second part of the present year's report deals with the expenditure of the various county councils on agricultural education of various kinds out of the funds they derive from the "whisky money." From this we learn that in 1905-6 the counties of England and Wales expended very nearly 84,000*l*., of which about 30,000*l*. went to colleges and schools, the remainder being spent on lectures or instruction in horticulture, bee keeping, poultry keeping, and various manual processes. Useful as no doubt much of this work is, popular as it is made to be by being spread thinly over a wide area and liberally endowed with prizes, it does little or nothing for the advancement of agriculture, though it may be doing something to make life easier for the cottager. The failure of agricultural instruction that is divorced from any permanent teaching centre may be read in the steady decline in the expenditure for such purposes of the counties which are not connected with any of the institutions subsidised by the Board. There are, indeed, several counties content to spend nothing on agriculture, though their only interests are agricultural, West Sussex, for example, spends not a penny, while several others get through on less than a hundred a year.

When one comes, however, to the second part of the title, "Grants for Agricultural Education and Research," this report makes an indifferent show, since the grants for research only total 355*l*.! Of course, some part of the grants to the colleges is available for research, but if we except the fine work that is being done at Cambridge, there is little going on at the colleges which could come under the category of research. The 355*l*. consists in the main of grants to various institutions carrying out a particular experiment on the improvement of poor pastures, and one sum of 50*l*. to the committee which is working at the improvement of English wheat. Rothamsted still remains without a grant.

Account should also be taken of one or two departmental committees which are inquiring into stock diseases; at present, for example, there is one at work on contagious abortion in cattle, and a former inquiry into "louping ill" in sheep has recently reported—the two costing about 3000*l*. But compare this expenditure on research with that of the United States Department of Agriculture; from the appropriations for the fiscal year ending June 30, 1905, we extract the following items for investigation work alone, exclusive of the salaries of the permanent officials of the Department:—

	£
Botanical investigations and experiments	13,500
Entomological investigations	14,000
Vegetable pathological investigations	30 000
Biological investigations	6,800
Pomological investigations	8 700
Laboratory Department of Agriculture	27,000
Experimental gardens and grounds, Department of Agriculture	5,000
Soil investigations	34 000
Grass and forage plant investigations	8,500
Cotton boll investigations	50 000
Sugar investigations	1,500
Tea culture investigations	2 000
Total	201 000

It is the smallness of the Board's contribution to research, the life blood of scientific education, which led Mr. J. T. Mason, the Member for Windsor, to move an amendment to the address last week to direct attention to the neglect of agricultural research on the part of the Government. Mr. Mason dwelt upon the prime importance of research to farming in this country, where intensive farming is carried on and a large monetary return per acre must be obtained. He instanced the losses that have been occasioned by plant diseases, which could only be dealt with after organised investigation of their causes and origin. He particularly pleaded for assistance to Rothamsted, the one institution for agricultural research of the first rank that this country possesses, but which, deriving its income from private benefactions only, is now handicapped for lack of funds.

The amendment received a sympathetic discussion from members on both sides of the house, and Sir Edward Strachey, for the Board of Agriculture, said "that no one was more anxious than he to see larger sums applied to experiment and research. But scientific investigation had suffered in the past not so much from neglect as from want of appreciation on the part of the public. If the House had omitted to provide sufficient funds for such investigation, it was because the question had not been brought forward. . . . On the other hand, it might very fairly be said that there was a general demand among agriculturists for larger grants from State funds, and the House might rest assured that the President of the Board of Agriculture would make representations to the Treasury as to the general feeling expressed in the debate on that point."

But now that the question is attracting public attention we trust that the Board of Agriculture will be encouraged to make bolder demands on the Treasury. There was a scheme for creating a council for agricultural research which seems to have fallen

through for lack of an initial grant, there are also the recommendations of the Royal Commission on fruit-growing, which seem no nearer realisation, as an advisory body the Board of Agriculture must get itself discredited unless it possesses some machinery for investigation.

THE UNIVERSITY OF TORONTO

THE very generous provision recently made by the province of Ontario for the financial support of the University of Toronto, as well as the very important changes brought about last year in the constitution of the latter, are of more than local interest, and therefore the following account may be of service to those who watch the development of the colonial universities.

This university, which was founded by Royal Charter in 1827 and began teaching in 1843, had as its original endowment 225,000 acres of Crown lands in the province of Upper Canada, now Ontario, and the amount realised from the sale of these lands gave, with the tuition fees, all the revenue the university had until 1897, when the Legislature granted it 1400*l.* a year and 132,000 acres of wild lands within the unsettled portions of the province. In 1901 the Legislature further undertook to pay the annual charge of the departments of physics, chemistry, and mineralogy and geology. This latter addition to the resources of the university was rendered necessary by the gradual decrease in the revenue from the endowment and by the great increase in the number of students in attendance, taxing the energies of the teaching staff and the accommodation of the class-rooms and laboratories to the utmost. Until 1906 the revenues were spent in supporting two faculties, arts and medicine, as the annual budget of the School of Practical Science (engineering and technical science generally) was met directly out of the provincial treasury.

This provision of 1901 met the situation for about three years, but in 1905 the need of additional laboratories and other buildings, as well as the continually increasing numbers of students, made the question of further financial aid a very pressing one. There was also the question of the advisability of changing the relations which hitherto existed between the State and the university. All appointments to the staff had been made by the Lieutenant Governor in Council, and though these had been free from political taint, there was the possibility of such being dictated by considerations of party politics. It was also recognised that the constitution of the university was very cumbrous and unadapted for the work it had to do.

The urgent aspect of the situation led the newly installed Whitney Administration to appoint a Royal Commission to examine and report upon the constitution of the university and its constituent colleges and faculties. The commission was a very representative one, and from the first it earnestly set about its task, which was recognised to be a difficult one. It visited the larger American universities, conferred with their presidents and others who could furnish any aid in the form of advice, and patiently heard the views of the staffs of the various colleges and faculties. This commission also took up the financial problem of the maintenance of the university.

The results of their labours were presented in the form of a report to the Lieutenant-Governor of the province in March of last year, and at the same time the commission drafted a bill for introduction into the Legislature to embody, in the form of an Act, the changes which were thought advisable in the constitution. The suggested changes practically involved re-casting the constitution. The Act was accepted by both sides of the Legislature, and only minor modifications were made in its passage through the House.

Some of the changes made were sweeping. The control of the university was vested in a board of governors, twenty in number, eighteen appointed by the Crown, one the chancellor, elected by the graduates, and one the president, appointed by the board. This board was given the management of the endowment and income, but it can make no appointment to the teaching staff except on the recommendation of the president, on whom now devolves the responsibility for the staff of the university. By the Act the School of Practical Science was made an integral part of the university, and its finances were made subject to the control of the board of governors.

By far the most important result of the Royal Commission's labours, and which was embodied in the Act of the Legislature, ensures to the university henceforth adequate financial support. The provision to this end consisted in the granting to the university each year one-half of the annual average amount of the revenues derived by the province from succession duties or death duties, the annual average to be based on the receipts of the preceding three years. The total amount of these duties for the years 1903-4-5 was 304,800*l.*, or annually 101,600*l.* One-half of this latter sum has, as the Act directs, been paid to the university for the academic year 1906-7. As the province is growing wealthy rapidly, and consequently these succession duties are annually increasing in amount, of course the sum to be handed over annually by the province to the university will correspondingly increase. The amount to be thus given for the academic year 1907-8 will be 71,000*l.*, and it is estimated that the university will receive from this same source in 1908-9 about 100,000*l.* What it will be in a few years more cannot be approximately forecasted, but it is not unlikely that within ten years the death duties may average 300,000*l.*, of which the university would receive 150,000*l.*

As the ordinary income of the university, apart from that derived from succession duties, and apart also from interest on scholarship funds, is about 44,000*l.*, it may be seen that the total income from all sources for 1906-7 is 97,400*l.*, and for 1907-8 about 118,000*l.*, but for 1908-9 it will be about 147,000*l.* It is not at all improbable that the income of the university five years from now may be in the neighbourhood of $1,000,000, or more than 200,000*l.*

This is a very large income, but it must be noted that the work that the university has to do is also very great. It has not to undertake instruction in agriculture, for the province already maintains a splendid College of Agriculture at Guelph, for which the annual budget is about 30,000*l.* It has, however, to provide adequately for faculties of arts, medicine, applied science, and education, and the task may be gauged from the fact that there are already 2700 students in the first three faculties. It has also to do for Canada what the great American universities are doing for the United States, that is, to meet the demand for advanced teaching and for research in all departments. It is, indeed, the ambition of some to develop the university into as great a representative of learning and research as either Harvard or Johns Hopkins is, and to make it at the same time a centre for the intellectual life of the Canadian nation to be. As it is now, it is the largest and wealthiest colonial university of the Empire.

A. B. MACALLUM.

PROF J F W VON BEZOLD

It is with deep regret that we record the death on Sunday last, February 17, of Prof Wilhelm von Bezold, director of the Prussian Meteorological Institute

Von Bezold was born at Munich in June, 1837, and was admitted to the degree of Ph D at Gottingen in 1860 Thence he returned to Munich as privat-docent in 1861, became extraordinary professor in the University in 1866, and ordinary professor at the Polytechnic in 1868 In 1878 he undertook the organisation of the Bavarian meteorological service as director of the central meteorological station, and remained in charge of the service until 1885, when he was called to Berlin as professor of meteorology in the University, and director of the Meteorological Institute, which was reorganised by him

The Institute included not only the central establishment in Berlin, which formed the headquarters of the branch in charge of Prof Hellmann for dealing with the climatology and rainfall of the Prussian kingdom, but also the meteorological and magnetic observatories at Potsdam, in connection with which the names of Sprung, Eschenhagen, and A Schmidt are so well known, and the aeronautical section at Tegel, which was brought into existence and developed as a branch of the Institute under Prof Assmann A year and a half ago the work of the latter institution was transferred to the new and independent establishment at Lindenberg

In the course of his long and distinguished scientific career von Bezold's activity ranged over a wide field His writings include papers on colour vision and the retina, and the dust figures of electrical discharge, but he is best known for his contributions to meteorology as the physics of the atmosphere, the aspect of the subject which he found most attractive and to the theory of terrestrial magnetism A volume of his collected papers on these subjects was issued as recently as October, 1906, by Vieweg and Son It includes the papers on the thermodynamics of the atmosphere, contributed to the Berlin Academy which are the classical memoirs upon that section of meteorology The last paper in the collection contains his proposal for testing Gauss's theory of terrestrial magnetism by measurements along a complete parallel of latitude This was before the Association of Academies in London in 1904, when von Bezold was one of the representatives of the Berlin Academy

All who had the advantage of being associated with him in international work will miss his kindly presence and scientific enthusiasm, as well as his sympathetic and cautious counsel

PROF N A MENSCHUTKIN

PROF NICOLAI ALEXANDROVICH MENSCHUTKIN, who died on February 5, was born in St Petersburg on October 24, 1842 After finishing his studies at the St Petersburg University, he went abroad and worked in the laboratories of Schtreker in Tubingen, Wurtz in Paris, and Kolbe in Marburg On his return to St Petersburg in 1865, he read his dissertation for the degree of Master of Chemistry on "The Hydrogen of Phosphorous Acid and its Incapacity to be replaced by Metals" In 1867 he began to lecture on chemistry at the St Petersburg University He also gave special lectures on organic chemistry, and was head of the analytical laboratory. In 1885 he left the analytical department and devoted himself entirely to teaching organic chemistry His doctor's dissertation was on "The Synthesis and Properties of Hydrocarbons" In the seventies of last century he was secretary, and in the eighties rector, of the Physico-mathematical Faculty In recent years he left the University and lectured at the Polytechnic Institute of St, Petersburg

Menschutkin devoted his spare time to the Physico-chemical Society, the Journal of which he edited He was vice-president of the Students' Aid Society, and, being a fine musician, he organised the students' choir and orchestra

His first researches were on the inorganic acids, but he subsequently devoted himself almost exclusively to organic chemistry In the 'seventies he did some good work in the province of physical chemistry and in the mechanics of chemistry His researches on the influence of isomerism of alcohols and acids on the formation of composite ethers were published in the Records of the St Petersburg Imperial Academy in 1877, and he was awarded the Sokoloff medal for this work This was his first fundamental work, and it marked an epoch in the history of Russian chemistry Prof Menschutkin supplemented these researches by further work on the same subject in 1881 His researches on etherification from 1877 to 1882 brought many important additions to that branch of organic chemistry In 1898, 1900, and 1902 he was occupied in investigating the influence of carbon chains on the velocity of reaction and decomposition of carbon compounds. His last important research was on the velocity of chemical change in the polymethylene series, which was translated into English and published in the Journal of the Chemical Society A paper on the "Influence of Catalysts on the Formation of Anilides" almost closes his scientific career

His "Lectures on Organic Chemistry" passed through many editions His "Analytical Chemistry" became the text-book for all the Russian universities and technical schools In his preface to the sixth edition, which has been translated into English and German, Prof Menschutkin claims that analytical chemistry should form the basis for the study of organic and physical chemistry Prof Menschutkin, unlike his contemporary Prof Mendeléeff was a wonderful manipulator in the laboratory, and this was partly the secret of the precision of his results Prof Mendeléeff had the wider vision of the science, Prof Menschutkin excelled in details His earliest work was much influenced by his first teacher, Prof Sokoloff

NOTES

IT was announced in Sunday's *Observer* that the Government would shortly introduce a Bill dealing with the constitution of the proposed Imperial College of Applied Science at South Kensington and the relation of the college to the University of London We find, however, that this report is incorrect though the scheme for the establishment of the college was outlined nearly four years ago when Messrs Wernher Beit and Co offered 100,000*l* towards the cost and the London County Council agreed to contribute 20,000*l* a year for maintenance the matter is still in abeyance This delay as we have remarked before is both unfortunate and dangerous The chief point at issue is whether the college shall form part of the University of London and be controlled by the Senate of the University or whether it shall be an independent institution having a governing body of its own While the relationship between the two institutions is being decided there is no visible sign that the scheme is taking definite shape, and many men of science and leaders of industry are becoming impatient at the delay The departmental committee on the Royal College of Science

and Royal School of Mines in referring to the composition and functions of the governing body of the new college remarked (see NATURE, February 8 1906 p 345) —"Of the relation of the new institution to the University of London it is necessary to premise that we are agreed that it is desirable that the new institution should be established immediately, and that its organisation should proceed without delay" With this recommendation we are in complete agreement When the college has been in existence for several years it will be time enough to decide what its connection with the University must be In the meantime, the special governing body proposed by the departmental committee ought to be appointed to start the institution If something is not done soon the enthusiasm with which the scheme for the establishment of the new college for advanced instruction and research in applied science was received will give place to public condemnation of the dilatory methods adopted in a matter of great national importance

PROF A LIPPMANN and Prof Simon Newcomb have been elected honorary fellows of the Physical Society

DR C D WALCOTT director of the U S Geological Survey has been elected secretary of the Smithsonian Institution in succession to the late Prof S P Langley

PROF J MILNE F R S, will deliver the opening lecture of the session at the West India Committee Rooms this evening February 21 the subject being "The Construction of Buildings in Earthquake Countries"

A STORM area of more than usual magnitude was influencing the weather over the whole of the British Islands and indeed over the greater part of western Europe during Tuesday night and Wednesday The central area of the disturbance was situated near Skudesnaes at 8 a m on February 20, the barometer registering 27·65 inches, which is probably a record low reading in that position The barometer was below 29 inches over nearly the whole of the United Kingdom and the fall was unusually rapid Strong westerly gales occurred throughout Tuesday night and they were continuing yesterday in all parts of our islands as well as in France

THE executive of the British Fire Prevention Committee has appointed a special commission on concrete aggregations The scope of the commission is described in the following resolution —"That having regard to the confusion existing as to concrete aggregates, and the absence of their exact specification the British Fire Prevention Committee do hereby constitute from among its members and subscribers a special commission to report upon and define the aggregates suitable for concrete floors intended to be fire resisting having due regard to questions of strength expansion and the chemical constituents and changes of the aggregates" In forming the commission the various technical interests have as far as possible been represented Sir William Preece K C B, F R S will act as chairman, and Mr Matt Garbutt is honorary secretary Correspondence should be addressed to the assistant secretary 1 Waterloo Place S W

THE February number of the *Century Magazine* contains a short article on Amundsen's expedition and the North West Passage, by General A W Greely A short outline (illustrated by a map) of the history of the search for the North-West Passage is given and General Greely writes appreciatively of Amundsen's skill and daring in the handling of the *Gjoa*, as well as of the value of the magnetic work he carried out

THE *Times* of February 5 publishes a telegram from Calcutta stating that a message had been received there on the previous day from Dr Sven Hedin Dr Hedin reached Ngangon Tso on January 21, and hopes to arrive at Shigatse at the end of this month The explorer says that the journey approaching completion is the most wonderful he has made in Asia in twenty-two years Eight hundred and forty miles of unknown country, on a line running diagonally across Tibet, have been explored and mapped in 184 sheets Many new lakes, rivers mountain ranges, and goldfields have been discovered, and the geographical results are said to be extraordinarily rich

LIEUT BOYD ALEXANDER, who, along with his brother Captain Claud Alexander, Captain G B Gosling Mr P A Talbot (surveyor), and a Portuguese collector, left this country in the spring of 1904 on an exploring expedition across Africa has returned to London Captain Claud Alexander died at Maifoni in November 1904, and Captain Gosling in the Ubangi-Welle region in June 1906 Much valuable work has been accomplished A careful triangulation has been carried out from Ibi in Nigeria, to Lake Chad, and the lake itself traversed in various directions Part of the course of the Shari was explored, from thence the Ubangi was reached and the expedition made its way northward to the little known region where many of the Bahr el Ghazal tributaries rise and down the Yei to the Nile The expedition has been particularly successful in collecting specimens in natural history including skulls bones and skins of the okapi

DETAILED investigations of the Calabrian earthquake of September 8, 1905 are now appearing We have received a memoir by Prof Rizzo on the rate of propagation of this earthquake, and a note published in the *Atti* of the Turin Academy of Sciences in which he discusses the depth at which this earthquake originated, and adopts 50 kilometres as the most probable value Another paper by Dr Mario Baratta, in the Journal of the Tuscan Academy of Natural Sciences deals with the distribution of the damage and shows that there were seven distinct centres of destructive violence, and that the earthquake was a true polycentral one Indirectly this paper shows that Prof Rizzo's estimate of the depth of origin founded on the assumption that the focus was simple and comparatively restricted in extent must be in excess of the truth so that 50 kilometres should be regarded as the maximum possible, not the actual depth of origin

PROF P CARMODY, who was an eye witness of the earthquake at Kingston on January 18, has sent to the *Times* some details of the disturbance, from which we have obtained the following particulars of scientific interest — The building material that has best withstood the shock is wood and next to this cement Brick has suffered most and stone is almost as bad An examination of the several streets in different parts of the town shows that generally the east and west walls of the buildings have collapsed, while those facing north and south have been but little injured This indicates that the earth movement ran east and west Another striking general feature is that the east and west walls have fallen away from the rest of the building, meeting together in narrow streets, of which there are many running north and south, and therefore making it impossible for anyone to escape uninjured from these narrow streets The streets running east and west have not been completely blocked by fallen débris partly because they are wider, but principally

because the walls running in this direction have suffered less. A peculiar alteration in the position of statues in the square is deserving of record, as it may subsequently throw some light on the direction of the earth movement. On the south side of the square is a statue of the Queen. The figure is turned slightly to the left on the pedestal. In a corresponding position on the north side of the square another statue is turned slightly to the right. The statue of Père Dupont, facing north-east, was thrown off the pedestal and lay broken on the ground; another statue facing west is snapped across the middle, and the bust has dropped on the lower part of the pedestal, but not overturned. These four statues are within a hundred yards or so of each other. In Kingston the earthquake was revealed to most persons by a strong swaying, side to side motion, which soon changed to a sharp up and down shake and then terminated. The grating of the bricks and stones as they slid over each other was the first sound that distinguished it from the ordinary West Indian earthquake. Gusts of wind blew after sunset, and between 7 p.m. and 8 p.m. another shock was felt. During the night this was followed by six or seven others, and these were repeated during the subsequent day and night, but without causing further appreciable damage.

THE London County Council has decided to issue, under the superintendence of Dr. A. C. Haddon, a series of handbooks to the ethnological collection of the Horniman Museum, Forest Hill. The first of these, compiled by Dr. H. S. Harrison, has just made its appearance under the title of "From Stone to Steel," being a handbook of the cases illustrating the Stone, Bronze, and Iron ages. It is well illustrated, and describes clearly and concisely the various types of weapons and implements met with in the superficial deposits of Europe. The chief types of the human race met with in Europe are also noticed, while a general survey of the history of stone and metal implements in non-European countries is added.

HORSE-BREEDING in Wisconsin forms the subject of Bulletin No. 141 of the University of Wisconsin Agricultural Station, issued in November last, the report being drawn up by Mr. A. S. Alexander. New laws for the licensing of stallions for public service in Wisconsin came into force in January of last year, and the present report deals with the working of these laws, and at the same time suggests such further enactments as appear necessary to improve the breed of horses in the State. Special attention has been directed to the elimination of unsound horses, and with the present powers it has been found possible to enforce the retirement of a considerable number of stallions coming under this category. The ultimate aim of the authorities is, however, to get rid of all but pure-bred stallions for stud purposes; but, as elsewhere, farmers and breeders do not respond as heartily as might be desired to efforts which are essentially for their own benefit.

"THE Laws in Force against Injurious Insects and Foul Brood in the United States" is the title of the sixty-first bulletin issued by the Entomological Bureau of the U.S. Department of Agriculture, the text being drawn up by Dr. L. O. Howard, the entomologist and chief of the section, and Mr. A. F. Burgess, secretary of the American Association of Horticultural Inspectors. Bulletins covering much the same ground were issued respectively in 1895 and 1898, and the publication of the present issue has been rendered necessary by the enactment of new laws and the active interest in the subject recently manifested by several States in the Union. From the preface, it appears to have been found impossible to bring the work absolutely up to date, although practically all the more important laws are included. The issue also includes an account of the annual meetings of the American Association of Horticultural Inspectors from 1897 to 1905.

IN the course of an article on the biology of the sandy tracts of Illinois, by Messrs. C. A. Hart and H. A. Gleason, forming the seventh part of vol. vii. of the Bulletin of the Illinois State Laboratory of Natural History, the first-named author observes that sand-dwelling insects display a remarkable similarity in colour to their surroundings, this being essential owing to their exposed condition. The similarity is chiefly restricted to the dorsal surface, and is noticeable in insects of all orders. In the case of the Carolina grasshopper, individuals taken from the sandy tract appeared to be paler than those from the surrounding darker ground. The moulting of these insects takes place in daylight, when the colourless fresh exterior is exposed to the action of rays reflected from surrounding surfaces, and it has been suggested by Vosseler that these rays may by some kind of photographic action produce an approximation to the general colour of the environment. How the effect is produced remains to be explained, but the explanation seems a probable one.

ACCORDING to *Beilage zur allgemeinen Zeitung* for January 30, an expedition is in course of being organised under the auspices of the Royal Academy of Sciences of Berlin and the Government of the Dutch East Indies for the purpose of exploring Java in search of further remains of Pithecanthropus. The originator of the idea appears to be Frau Prof. Selenka, widow of the late Prof. Selenka, of Munich, who has already travelled extensively in Borneo for the purpose of collecting embryos of the orang-utan. Dr. Elbert is attached to the expedition as geologist, whilst Dr. Moszkowski, of Berlin, goes out as zoologist. A Dutch engineer, Mr. Oppenoorth, will have charge of the surveying and excavating operations. The Pleistocene volcanic breccia from which the original remains of Pithecanthropus were obtained by Prof. Dubois at Trinil is believed to have a wide extent in the mountains of Java, reaching in some places to a height of 100 metres or more above sea-level, and it is proposed to examine this stratum thoroughly in a number of the more promising localities. We may cordially endorse the hope expressed by our German contemporary that the expedition will succeed in its object, and bring to Europe a collection which will throw some definite light on the ancestry of the human race.

THE *Times* of February 4 contained an article on the grouse disease inquiry, summarising the results of the work of the departmental committee up to the present time. The committee, it will be remembered, was appointed by the Board of Agriculture, with the proviso that it was to find its own funds. It is for the most part composed of owners of grouse-moors, with Lord Lovat as chairman. From the point of view of progress in the inquiry, it is unfortunate that the work of investigation has coincided with a period of complete health among British grouse. The article criticises, not altogether favourably, a pamphlet issued by the committee under the title of "Notes on the Grouse," purporting to give a *résumé* of all that is known about the disease. Among its omissions is the absence of any reference to the theory that the midge may be the carrier of the infection. Whether

Klein's bacillus is really the cause of the disease must for the present be left open. Much time has been spent in searching for this organism, but hitherto without success. If the bacillus "should, after all, prove to have nothing to do with the disease, all this time will have been lost. It is not suggested that this will prove to be the case, but merely that it would have been better to start with an open mind on that point as well as upon others." It is pointed out that as no progress can be made while the disease is in abeyance, and that the original subscriptions to the committee were to last for three years only, further financial means will be required with the recrudescence of the malady in the future if any definite results are to be obtained.

THE Proceedings of the Cotteswold Naturalists' Field Club and the Transactions of the Hull Geological Society are excellent examples of the way in which the work of local societies may be produced. The former is printed by the historic house of John Bellows, in Gloucester. In the part for September, 1906, Mr. S. S. Buckman has a handsomely illustrated paper on Schlotheimia and species of other genera of Liassic ammonites. The reports of various excursions are accompanied by useful landscape-views. The Hull Geological Society, in its issue styled "vol. vi., part 1, for the years 1901–5," published in 1906, gives us Mr. Danford's detailed investigation of the belemnites of the Speeton Clay, with four remarkably fine plates of photographs, taken, like Mr. Buckman's, from the actual specimens. One is tempted to ask, however, whether the money spent so liberally on such papers would not have been better devoted to their production in the *Geological Magazine*. The excellent records of local surface-changes in Yorkshire, by Messrs. Butterfield and McTurk, and Mr. Richardson's note on Ceratodus from Westbury-on-Severn, stand, of course, in another category. The judgment of scientific readers must often be suspended between regret at the scattering of valuable work and admiration at the zeal with which it is put forward in its place of origin. It must be admitted that local publications of so high a standard are in themselves a stimulus to research.

THE Journal of the Royal Sanitary Institute for February (xxviii., No. 1) contains an important paper by Prof. S. Delépine on testing the germicidal power of various substances by the thread method, in which it is concluded that nearly all the problems of disinfection can be studied by means of it. Dr. Newsholme contributes a paper on the voluntary notification of phthisis in Brighton, and Dr. Heron one on coordination of measures against tuberculosis.

THE report from the Select Committee on the Housing of the Working Classes Acts Amendment Bill, which was recently issued, contains some important recommendations, particularly as regards sanitary administration. It is found that at present sanitary control is imperfect, and that the administration of the Acts by the rural district councils is neglected. Among the recommendations are transference of the administration of the public health and housing laws to the county councils, the provision of medical officers of health, properly qualified and adequately remunerated, so that they can devote their whole time and energies to the duties of their office, the provision of an expert staff of inspectors under the medical officer, whose title shall be altered from that of "Inspector of Nuisances" to "Sanitary Inspector", and the registration of every house and tenement in rural districts. It is considered that small local authorities cannot satisfactorily frame and administer building and public-health bye-laws, and it is suggested that the Local Government Board should establish a staff of officers for the special purpose of supervising the construction, sanitary condition, and repair of houses under the Public Health Acts, and the provision of houses under the Housing Acts.

No. 25 of the "Scientific Memoirs of the Government of India," by Captain S. R. Christophers, is devoted to a consideration of the importance of larval characters in the classification of mosquitoes. It is suggested therefrom that Stegomyia should be removed from the Culicina and placed in a group, *Stegomyina*, of its own; that Megarhinus and Toxorhynchites together with Mucidus and Psorophora (removed from the Culicina), should form a separate group, &c. Memoir No. 26, also by Captain Christophers, deals with the *Leucocytozoon canis*, a protozoan parasite of the white blood corpuscles of the dog, first described by Bentley and later by James. According to Christophers, *L. canis* comes within the division Hæmogregarina of Laveran, and very possibly represents the mammalian form of Karyolysus (Labbé). Reproduction occurs by the formation of true cysts containing about thirty sporozoits. Encystment takes place in cells of the bone marrow. After escaping from the cysts, the sporozoits invade mononuclear transitional cells in the marrow, where they are seen as naked, oval forms. These undergo changes and become encapsuled, whilst the host cell is altered in a characteristic way. The complete sexual development of this parasite takes place in the dog-tick (*R. sanguineus*).

THE *Kew Bulletin* was initiated in 1887, and although for a period the annual volumes were in abeyance, the series is now complete for a period of twenty years. The director of the gardens has recently issued an index as appendix v. to last year's volume detailing the contents from the commencement of the journal to the end of last year.

THE numbers of the *Agricultural News* (December 29, 1906, and January 12, 1907) lately received contain references to the agricultural conference at Jamaica that was so disastrously cut short. With regard to rubber in British Guiana, an expression of opinion by Dr. Bovallius is quoted wherein species of Sapium are recommended for cultivation on the lowlands in preference to Hevea and Castilloa, that require to be planted at a higher elevation.

SEVERAL references have appeared recently in the morning journals to an alleged cure for the opium habit emanating from the Straits Settlements. Mr. E. M. Holmes, writing to the *Times*, January 22, states that the plant has been identified as *Combretum Sundaicum*, a woody climber growing abundantly on the plains around Kuala Lumpur, in Selangor. Further information is supplied in the *Pharmaceutical Journal*, January 26, where Mr. Holmes says that it would be premature to express a definite opinion until a larger quantity of the material is available for chemical analysis and physiological investigation.

IT is probably unknown to many pteridologists that crested and other "sporting" ferns may not infrequently be collected in the British Isles. Mr. C. T. Druery, who has found several wild "sports," writing in the Journal of the Royal Horticultural Society (December, 1906), quotes as two instances the discovery of a markedly crested form of *Athyrium filix-foemina* at Kilrush, Ireland, and the

growth of a crested variety of bracken at Faygate, Sussex. Other papers in the same journal include an article on horticulture in relation to medicine and notes on tufted pansies, hollies, and the ideal potato. In the first named Mr. E. M. Holmes furnishes a list of plants now cultivated as herbs, among which one unexpectedly finds the nettle and mallow; an account of medicinal plants suitable for cultivation in this country is also given.

ACCORDING to the report of the Department of Agriculture in the Madras Presidency for 1905–6, a large experimental area has been acquired at the village of Taliparamba, in the Malabar district, for growing pepper vines with the object of studying their morphology, varieties, and other problems connected with their cultivation. Under the control of Mr. C. A. Barber, the results are likely to add materially to our knowledge of this historically and economically interesting product, and will, it is hoped, resuscitate the industry in South India. Other important products receiving attention are sugar-canes, ground-nuts, cotton, and tobacco, but experiments are not sufficiently advanced to furnish conclusions. The manufacture of door-mats, napkins, and muslins from the fibre of *Agave vivipara* is an extension of the usual applications of this fibre.

THE Cycads are so few in number, and they occupy such an important position in plant taxonomy, that a paper embodying new researches cannot fail to be interesting. As the outcome of an expedition to Chavarillo in the Mexican tropics, Prof. C. J. Chamberlain was able to secure material of the little-known ovule of the genus Dioon, and his results are published in the *Botanical Gazette* (November, 1906). The author obtained a series of stages from the appearance of the archegonium initial cell to the germination of the seed. The archegonia are formed in October to the number of four or five in each ovule; a neck cell is cut off, and subsequently a ventral canal nucleus separates mitotically from the egg nucleus. Haustoria are developed in connection with the transference of nourishment to the egg cell. The nucleus of the ovum is the largest known in plants, and contains twelve chromosomes. Incidentally, the author concurs with the opinion that plants of Dioon may continue to live for a thousand years.

A NEW journal bearing the title *Gaceto Matematika Internacia* is to be published in Esperanto. It will contain original articles on theoretical and applied mathematics, mechanics, and theoretical physics, reprints of articles published in other languages, reviews, correspondence, biographies, and papers on the history and teaching of mathematics. It is not intended to compete with, but rather to supplement and strengthen, existing journals. The publisher is F. J. Vaes, Mathenesserlaan 290, Rotterdam.

MR. B. M. DUGGAR details some experiments to ascertain the value of the osmotic pressures in the cells of certain marine algæ in a paper published as vol. xvi., No. 8, of the Transactions of the Academy of Sciences in St. Louis. Common salt, nitre, and sugar were used to make plasmolysing solutions, both in distilled and sea-water. It was found that the amount of nitre in sea-water required to plasmolyse together with the equivalent value of the salts in the sea-water was less than the amount in the fresh-water plasmolysing solution, while the reverse held good for sugar. An attempt to examine the toxic effects of adding to sea-water additional amounts of the different constituent salts occurring in sea-water elicited the facts that magnesium salts ordinarily toxic to phanerogams and fresh-water algæ were almost inert, and ammonium compounds were the most active.

FROM Messrs. Burroughs, Wellcome and Co. we have received a copy of the 1907 edition of their "Photographic Exposure Record," which is familiar to most of our photographic readers. It is bound in art green canvas, and is issued at a shilling. This neat pocket-book has been brought well up to date, and, as we have pointed out on previous occasions, should be the *vade mecum* of every photographer. Even in this small compass a great amount of useful information is compressed, in spite of increased space being provided this year for the record of negative exposures, there being room now for 336 entries. Each copy is accompanied by a folding card for hanging up, which gives useful information regarding the timing of development by the factorial method for various degrees of contrast, and particulars of equivalent plate speed numbers according to the different systems in use. An entirely new series of examples illustrates the article on exposure.

MR. JOHN C. PACKARD, of the High School, Brookline, Mass., sends us a description of an apparatus he has devised to determine the resultant of two motions at right angles to one another, one uniform, the other uniformly accelerated. A steel ball 1 inch in diameter, is placed at the top of an inclined plane of plate glass, and is made to acquire a uniform motion in a horizontal direction by being rolled down an auxiliary incline behind a ledge; the ball is then allowed to roll down the glass plane. A tracing of the curve generated by the ball is secured by fixing a sheet of squared paper to the plane and a piece of soft carbon paper over it. The ball in rolling over the carbon paper leaves its trace on the squared paper beneath. A study of the curve thus generated enables the pupil to arrive at the laws of uniformly accelerated motion.

A FOURTH edition of an "Introduction to Physical Chemistry" by Prof. James Walker, F.R.S., has been published by Messrs. Macmillan and Co., Ltd. The work has been enlarged by the inclusion of sections dealing with the behaviour of radio-active elements, atomic and molecular dimensions, and neutrality and salt-hydrolysis. Newer data afforded by recent researches have been substituted for the numerical values of previous editions.

WE regret that in a short notice of Prof. G. S. Boulger's work on "Familiar Trees" in NATURE of January 31, the reviewer was under a misapprehension when he remarked that certain trees had been omitted. The book reviewed is only the first volume of a new edition of Prof. Boulger's work, which is still being issued in fortnightly parts, and the missing species will be dealt with in another volume. The volume should, we consider, have been described as vol. i. on the title-page instead of using the words "First Series."

THE authorities of the British Museum (Natural History) have recently adapted the telephoto lens for securing accurate photographs of specimens. The installation consists of a 12×10 camera with an extension of 4 feet fitted with an 18×16 rectilinear lens and telephoto attachment, the whole apparatus being made by Messrs. J. H. Dallmeyer, Ltd. It has proved very successful, the improvement in perspective and depth of definition in the photographs being very noticeable when compared with those taken on the same scale with an ordinary lens.

OUR ASTRONOMICAL COLUMN

THE RECENT SOLAR ECLIPSE IN INDIA.—From a brief paragraph which appears in the *Pioneer Mail* for January 25 we learn that some interesting photographs of the partial eclipse of the sun were obtained at Dehra Dun (N.W. Prov. India) on January 14. A drop in the temperature of 4° corresponded with the passage of the shadow, and there was a very marked decrease in the illumination of the surrounding landscape. Venus became clearly visible to the naked eye.

THE LATE DR. ROBERTS'S CELESTIAL PHOTOGRAPHS.—A preliminary catalogue of Dr. Roberts's collection of photographs of various celestial objects and regions, comprising some 2485 original negatives, is published by Madame Dorothea Isaac Roberts in No. 4154 of the *Astronomische Nachrichten* (February 9). An introductory statement which accompanies it gives a brief account of the various classes of negatives, the period during which they were obtained, and the instruments employed by the observer. A complete list of Dr. Roberts's tribute to astronomy is to be published as soon as circumstances permit, and as the number of copies of the paper will be limited, those interested in photographic astronomy, and desirous of receiving a copy, are requested to send in their names at once to Madame Dorothea Isaac-Roberts, Château Rosa Bonheur, By-Thomery, S.-et-M., France. Positives on glass reproduced from the Isaac Roberts negatives will be lent for the purpose of micrometric measurements if application be made, and provided that the documents be returned after the completion of the measurements.

A LOST COMET (1905*f*).—Whilst examining three photographs taken at Mount Wilson on July 22, 1905, Prof. Barnard found the trail of a comet which appears to have evaded all other observations, and as the object might prove to be a periodic comet he now publishes some measures of position which he has made in order to determine, if possible, an approximate orbit, in No. 4153 of the *Astronomische Nachrichten* (February 6).

The positions (1905.0) of the comet at the beginning and end of the trail were:—

$$\text{R.A.} = 18\text{h. } 23\text{m. } 16.4\text{s.} \quad \delta = -20^\circ 30'.0$$

at 16h. 20m. G.M.T., and

$$\text{R.A.} = 18\text{h. } 23\text{m. } 41.2\text{s.} \quad \delta = -20^\circ 31'.0$$

at 18h. 55m. G.M.T., respectively; the position angle and length of the trail were found to be 288° 24′ and 368″, thus giving a daily motion amounting to 3m. 49.5s., 17′ 55″. On examining the Harvard plates for this date Miss Leavitt was unable to find any trace of the object, which must have been much smaller than Giacobini's 1905 III comet, and at least six or eight times less bright.

THE SPECTRUM OF MIRA.—Four photographs of the spectrum of Mira were obtained at the Lowell Observatory during the recent maximum of the star's brightness, and a brief discussion of them is published by Mr. V. M. Slipher in No. 1, vol. xxv. (February), of the *Astrophysical Journal*. The first spectrogram, obtained on December 13, 1906, included the region λ 4300 to λ 5000, and shows both Hβ and Hγ as strong, bright lines. The second photograph was taken on December 18, and shows the four hydrogen lines Hα, Hβ, Hγ, and Hδ as bright lines increasing in intensity in the order given, Hα being notably weaker than the others. Numerous absorption bands, sharp and intense on their more refrangible edges and gradually fading out towards the red, are shown, in addition to the hydrogen lines, on the plate taken on December 21. On the last plate, taken December 24, all the hydrogen lines were bright, Hα being bordered on the violet side by a strong and rather broad absorption line. Of the metallic absorption lines those due to vanadium are recorded as being especially strong.

SUN AND PLANET CHART.—We have received, from the firm of Carl Zeiss, 29 Margaret Street, W., a copy of a very useful chart which enables a ready determination to be made of the position of the sun, or of any of the planets, in regard to the fixed stars during 1907. It consists of a chart of the equatorial constellations, together with right ascension and declination curves, on the same scale as the chart, of the objects to be found. By simply drawing ordinates for the required date, as found on the chart, and projecting the points where they intersect the R.A. and declination curves on to the star chart, the relative position of the sun or planet may be determined in less than one minute.

THIRTY-SIX NEW VARIABLE STARS.—By superposing positive and negative copies of six photographs taken with a 1-inch Cooke lens, Miss Leavitt discovered thirty-six new variable stars in a region 30° square, having its centre at R.A. = 12h., dec. = −60°. These variables are mostly situated in the constellations Carina and Centaurus, and six of them are probably of the Algol type. Nova Velorum was discovered, and sixteen known variables were rediscovered on the same plates (Harvard College Observatory Circular No. 122).

SEISMOLOGICAL NOTES.

Valparaiso Seismograms.

ON August 17, 1906, Valparaiso was visited by an earthquake of unusual severity. Seismograms of this disturbance were obtained at all observatories throughout the world which were properly equipped with apparatus to record teleseismic motion. The seismograms obtained in this country, as was pointed out to me by Mr. R. D. Oldham, and noted by other observers, exhibit a dual character. This duality is clearly seen in the annexed seismogram from Kew, reproduced by the kind permission of Dr. R. T. Glazebrook. After preliminary tremors, there is a "shock" or maximum, marked A, at 1.5 G.M.T., and a second "shock" or maximum, marked B, forty-five minutes later, or at 1.50. If the latter shock originated in or near to Valparaiso, and took 1h. 5m. to travel from that part of the world to Britain, it originated there at 7.59 in Valparaiso time. The most accurate time received from Santiago is 7.58.40, or practically 7.59. We may therefore conclude that B represents the disturbance which led to devastation in Valparaiso and places in that vicinity. The question now arises as to what is shock A at 1.5 G.M.T. From the duration of its preliminary tremors it evidently came from some place about 105° distant, which happens to be the situation of Valparaiso, and the time of its origin, wherever that may have been—Central Asia or South America—was in G.M.T. 0h. 0m. (7.14 Valparaiso time), but up to date I am not aware that the inhabitants in Valparaiso know anything about a shock at 7.14. Shock A and shock B may have a direct relationship, or they may be independent disturbances which occurred about the same time. Together they make a jumble which might be compared with the meeting of waves at the mouths of two opposing estuaries. The International Seismological Association, which met last year in Rome, issued from its headquarters in Strassburg a circular to seismological stations generally asking for seismograms of "the Valparaiso earthquake." These and a variety of detail about instruments and the stations where seismograms were obtained are to be placed before the delegates of that association when they meet at the Hague for their study.

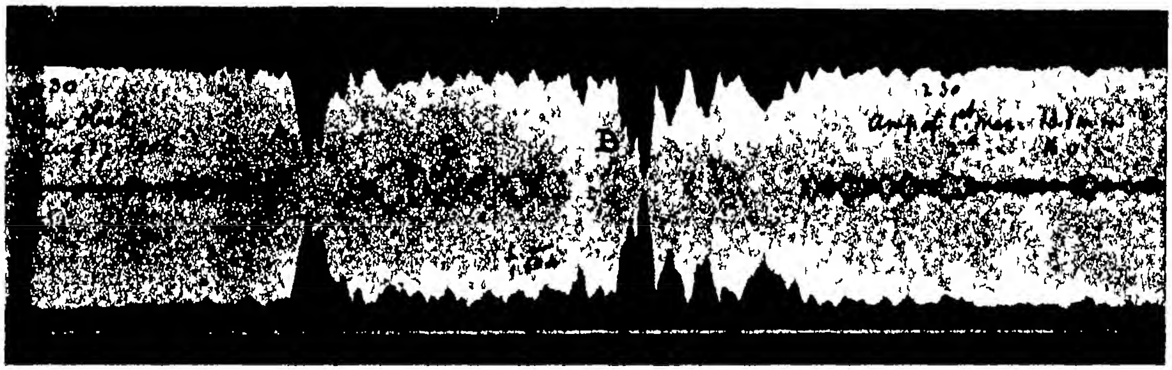
A New Seismometer.

The International Seismological Association offers prizes of 50*l.*, 35*l.*, 25*l.*, and 15*l.* for the construction of a seismometer. It is to record earthquakes which have their origin near to the place of observation, which we assume means earthquakes that can be felt. It must register both horizontal and vertical movements. No doubt the authors of this condition are well aware that vertical displacements are accompanied by angular displacements. Any recording seismometer under the influence of vertical movement at its best becomes an indifferent variety of clinometer. Usually its records have no more value than those from a seismoscope. One remarkable condition is that the new instrument must have a magnification of not less than forty to fifty times. Seismographs used in Japan, and by all who have had experience in recording earthquakes of local origin, find a magnification of from six to ten quite sufficient. If a shock has a range of a quarter of an inch, which in soft ground may well be the case, this

would appear on the record receiving surface of the new seismograph more than a foot or 30 cm in length. It is, of course, possible to construct a large record receiver, but is it necessary? About a record of time, which is probably the most important element required by the working seismologist, nothing whatever is said.

Seismographic and other Record receiving Surfaces.

The record receivers to which I refer are the types used in connection with horizontal pendulums adopted by the British Association, and now in use at many stations widely distributed round the world. Nearly all of these record on a surface of photographic paper moving at the rate of 60 mm. per hour. There are, however, one or two instruments where the paper moves at a rate of about 250 mm. per hour. With very large earthquakes, the times of commencement or the commencement of the preliminary tremors, as recorded on either the slow or comparatively rapidly moving paper, are identical, the seismographs being similar and placed side by side. With earthquakes of moderate intensity this is not always the case. On the slowly moving paper the commencement of the preliminary tremors may be lost. The explanation apparently rests in the fact that slowly moving paper passing beneath two illuminated cross slits or an illuminated "pin-hole" has a longer exposure than that which is moving quickly. The longer the exposure the broader the line. In one case the film takes about twelve seconds to pass beneath the "pin hole," and in the other between two and three seconds.



Seismogram of the Valparaiso Earthquake, August 17, 1906.

In either case, when the boom of the pendulum, which at its outer extremity carries the equivalent of a "pin-hole," is steady, we get a straight line on the film moving beneath the same. Very slight movements of the boom, however, are to be seen on the film which has passed quickly beneath its spot of light which cannot be seen on the film which has moved slowly. On the latter minute ripples have been eclipsed in the broadened line. The meaning of this, not only to practical seismologists, but to all who have to deal with photographic recording apparatus, is that the best result which can be obtained from a given instrument largely depends upon the speed of the photographic record-receiving surface.

JOHN MILNE.

SCIENCE IN INDIA.[1]

THE "narratives" from which extracts have been taken for publication in the report before us are those of officers of the Indian Survey Department who are employed on work of scientific investigation. There is little of topographical, and nothing of geographical, interest in them if we except certain results derived from Captain Wood's mission to Nepal. They afford, however, most convincing proof of the strenuous nature of the work of the scientific branch of the department, and should serve amply to justify the maintenance of a well-matured system of scientific investigation in the eyes of those critics who are disposed to assert that India cannot afford to be scientific.

No less than 128 pages out of the 187 which comprise the report are devoted to the reproduction of tables giving the results of magnetic observations, which are further illustrated by a map showing the stations of observation of the magnetic survey. Since the year 1901, these have been carried practically over the whole peninsular area with the exception of the Central Provinces. A description of some of the stations and of the instruments used completes the narrative, but no general deductions are made, nor is any indication afforded as to the practical result of these undoubtedly valuable observations.

Major Conyngham's report on the pendulum observations for determining the force of gravity is directly interesting. The latest instrumental equipment for this class of observation includes "half-second" pendulums, which are only one-quarter the length of those previously used in the department. A new method (an Austrian invention) has also been introduced for registration of the coincidence of beat between the free pendulum and the clock pendulum, the pendulums being no longer swung *in vacuo*. A considerable increase in accuracy of observation has thus been assured, further refinements being introduced in the corrections applied for the minute vibrations (or "wagging") of the stand on which the instrument is fixed due to the swing of the pendulum. Some of the results are curious. For instance, it was found at Calcutta that the perpetual tremor, or vibration, set up by traffic, due to the nature of those alluvial deposits on which the city may be said to be floating, absolutely negatived the value of the observations, whilst, on the other hand, observations taken at Colaba, in Bombay, were not affected appreciably by the firing of the big guns of the fort in their vicinity.

The value of "g" (force of gravity) being used to determine the figure of the spheroid and the density of the earth's crust, it was found at Colaba that the excess of attraction indicated by the observations equalled that which would be accounted for by a disc of earth matter below the instrument 2530 feet thick with an excess of density equal to 2.8 above the average of surface density. At Dehra Dun on the other hand the defect in "g" indicated a deficiency in density of 2.8 extending to 2930 feet in depth. Assuming that the surface density is 2.8, this means that we must imagine a cavity 2930 feet deep under Dehra Dun, in other words, "the matter underlying Dehra Dun is so deficient in density—we do not know to what depth this deficiency may extend—that it would have to be pressed downwards until the surface of the land was 2930 feet below its present position before it would attain the average density of the crust of the earth. Likewise at Colaba an expansion of the underlying strata until a hill 2500 feet high had been formed would be requisite to reduce the excessively dense rock that is found here to the average density of 2.8."

Certain levelling operations referred to in another part of the report have been undertaken in the interests of these

[1] "Extracts from Narrative Reports of Officers of the Survey of India for the Season 1903-04." Pp. 187. (Calcutta.)

pendulum observations to determine the difference of level between Dehra Dun and Mussoorie

Valuable results still continue to be obtained from the tidal observations, which extend over forty-two ports from Aden to Port Blair Tide tables for forty ports are now published in England based on the observations of the Indian Survey Several instructive tables will be found in the report, especially those showing the errors in the predicted times and heights of high and low water at the various stations These tables apparently indicate a superiority in the automatic system of recording

Amongst the most interesting records of the season are the results obtained by a careful re-computation of Captain Wood's observations for determining the position of Everest and other high peaks in Nepal The more rigorous methods employed give a very slight difference (never amounting to half a second of arc) between the new and old determinations of the coordinate values of the stations of observation, which differences are reflected in a greater degree in the values of the peaks observed, but the corrections in altitude of the peaks observed, due to the employment of a revised coefficient for refraction, are more marked The height of Mount Everest, for instance, is reduced by about 300 feet (28,700 feet instead of 29,000 feet), and a general reduction in altitude of most of the peaks is apparent This, however, must not be accepted as a final determination There are other factors in the computation of altitudes observed under extraordinary conditions still to be determined with more rigorous exactness, and it is quite possible that the ultimate altitude of the highest mountain in the world may be fixed at a higher figure than 29,000 feet rather than a lower one

A short statement of the progress of topographical surveys in Sind (with no narrative of any interest) and of riverain surveys in the Punjab with a few notes on town and municipal surveys generally, completes the report

THE NEEDS OF THE UNIVERSITY OF CAMBRIDGE

TEN years ago the Duke of Devonshire, as Chancellor of the University of Cambridge, directed attention to the resources and the needs of the University, and at the beginning of 1899 the Cambridge University Association was formed The progress towards the re-endowment of the University, which it is the object of the association to promote, is described by the Chancellor in a letter of which a copy has been sent to us, and is here summarised

The sums which the Cambridge University Association has been able to transfer to the University amount in all to about 115,000*l* Of this total a considerable portion was allotted by the donors to the building of the new medical school, the school of engineering, the proposed new buildings of the Cavendish Laboratory, the school of agriculture the museum of archæology and ethnology, and to the University library, but a large proportion has been available for general purposes

Although the progress already made in the equipment of the several departments must be regarded with satisfaction few of the other wants keenly felt in 1899 have yet been met, and in certain cases new wants have inevitably arisen during the last seven years In the scientific departments every year must of necessity bring new demands for specialisation in teaching and for the provision of facilities for research In some departments, notably those of agriculture engineering, and chemistry, the number of students has greatly increased, and additional accommodation is required

The greater of the immediate needs of the University may thus be stated The sum of 18,000*l* promised for the University library represents only the first instalment of a capital sum of 148,000*l* required Chemistry requires 10,000*l* capital and 2000*l* income, physics, 12,000*l* capital and at least 1000*l* income engineering, 10,000*l* capital, and income and equipment for research, botany, 1000*l* capital and 250*l* income, physiology 10 000*l* capital and 1800*l* income, agriculture, 20 000*l* capital (of which 12 000*l* has been promised) and 600*l* income, the medical school will cost at least 20,000*l* to complete, and in addition a considerable sum is needed for the provision of instruments, &c, and a large income for additions to the teaching staff Geology asks for 2800*l* capital and 1300*l* income A new, or at least a greatly enlarged, museum of zoology will shortly become necessary, and an income of 1500*l* is also required for this subject Entomology, a subject of great importance in its relations to forestry and tropical medicine, is in need of 10,000*l* capital Oriental studies require 2000*l* income A new museum of archæology and ethnology, urgently needed for the preservation, and for the display for the use of researchers, of the valuable collections possessed by the University, will cost 25,000*l*, and a considerable income will be required for staff and maintenance History is in need of 800*l* income, and a sum for the provision of lecture rooms Economics require 2000*l* income, the moral sciences (including experimental psychology) 1400*l* capital and 1250*l* income Classics require about 900*l* income and mathematics capital for new lecture-rooms and 3500*l* income Law asks for 600*l* income Modern languages urgently require a sum sufficient to create professorships in at least English, French, and German (at present represented by two readers and a lecturer), and to ensure the proper representation of other modern languages There are other needs, some of them not intrinsically less important than those mentioned, but demanding more modest sums for their satisfaction

The disabilities arising from the low scale of existing salaries are common to almost every department The average stipend of a professor is but 550*l*, and that of a university teacher, other than a professor, 250*l* per annum and these figures include the emoluments received from fellowships and from fees The disability is increased by the fact that the University *can set aside only 200l per annum to form a pension fund for its forty-four professors*, and nothing at all for other teachers There is, in addition, need for the creation of many new posts

If the University is to retain the services of its most distinguished men it is imperative that the income assured to them both during and after the period of active work, should bear comparison with what they may obtain in similar positions elsewhere

It is stated that in all a capital sum of nearly one million and a half, apart from any question of a pension fund for professors might without extravagance be immediately expended on the equipment of, and on the provision of staff for the University

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE —The professorship of agriculture in the University was established in the year 1899, in consequence of a generous offer by the Drapers' Company to contribute 800*l* a year for ten years to the agricultural education fund, for the stipend of the professor The Drapers' Company has now signified its intention to continue its contribution of 800*l* a year for a further period of ten years, dating from the year 1909, on the understanding that the Department of Agriculture, and the stipend of the professor, shall be maintained as at present. The company has further expressed approval of a suggestion made by the board of agricultural studies, that the source of the endowment should be indicated, as in the case of some other foundations, by attaching to the chair the title of the "Drapers' Professorship of Agriculture"

The following have been appointed members of the board of electors to certain professorships —Dr Keynes and Mr W E Johnson, of King's College to that of the Knightsbridge professorship of moral philosophy, Mr F H Neville, of Sidney Sussex College, to that of the professorship of chemistry and to that of the Jacksonian professorship of natural philosophy, Prof Forsyth, to that of the Plumian professorship of astronomy, Prof Howard Marsh, to that of the professorship of anatomy Prof S H Vines, to that of the professorship of botany, Dr Bonney, to that of the Woodwardian professorship of geology and to that of the professorship of mineralogy; Sir Thomas Barlow, Bart, to that of the Downing pro-

fessorship of medicine, Dr Gaskell, to that of the professorship of zoology and comparative anatomy, Dr Keynes, to that of the professorship of political economy, Dr W N Shaw, to that of the Cavendish professorship of physics; Prof. J J Thomson, to that of the professorship of mechanism and applied mechanics, Prof C S Sherrington, to that of the professorship of physiology, Prof. Nuttall, to that of the professorship of pathology, the Hon. B A W Russell, to that of the professorship of mental philosophy and logic, and Mr A. E Shipley, of Christ's College, to that of the professorship of agriculture.

The teachers' training syndicate has appointed Dr Rouse, of Christ's College, O Browning, of King's College, and J Wallis, of Christ's College, as delegates to attend the International Congress on School Hygiene to be held in London next May

PROF. H McLEOD, F R S, is to receive the honorary degree of LL D from the University of St Andrews at the graduation ceremonial on April 2

PROF. THOMAS LOVEDAY, professor of philosophy at the South African College, Cape Town, has been appointed librarian to the University of Sheffield

ARRANGEMENTS have been made for establishing a distinct department of the Board of Education to deal with all grades of education in Wales and Monmouthshire Mr A T Davies has been appointed permanent secretary of this Welsh Education Department, and Mr O M Edwards chief inspector for Welsh education, and both will be directly responsible to the president

A REUTER message from Pittsburg announces that the Western University of Pennsylvania will confer the honorary degree of LL D upon the following gentlemen, among others, who will be present at the Founders' Day celebrations of the Carnegie Institute on April 13 next — Sir Robert Ball, Sir William Turner, K C B, Sir William Preece, K C B, Signor Marconi, Mr Chalmers Mitchell, Dr John Rhys, and the Rev E S Roberts, master of Caius College, Cambridge

A RECENT issue of *Science* contains further striking instances of the importance attached to higher education by wealthy American citizens Rensselaer Polytechnic Institute has received a gift of 200 000*l* from Mrs Russell Sage The money will be used for the school of mechanical and electrical engineering Mrs Sage has also given 200,000*l* to the Emma Willard School of Troy The establishment and permanent endowment of Peabody College for Teachers, at Nashville, Tennessee, has also been assured The Tennessee legislature has just passed a Bill providing the college with 50,000*l* The city of Nashville has given 40,000*l*, and the county of Davidson 20,000*l* These gifts have been made in response to a proposition from the Peabody Education Board to endow the college with 200 000*l* All the conditions imposed by the Peabody Board have now been complied with, and it only remains for that board to organise the institution The college will have 310,000*l* in money In addition to this, the University of Nashville has given the grounds and buildings now occupied by the college, valued at 50,000*l* It is understood also that gifts will be received at once from other sources amounting to about 200,000*l* We also notice that by the will of Arthur Mills, of Brookline, Harvard University will ultimately receive 30,000*l*

IT is satisfactory to learn from the annual report that the Geographical Association, which is doing very useful work in promoting the study of geography in schools by scientific methods, is making substantial progress In many schools geography is still regarded as a collection of names and phrases which convey no real meaning to the pupils but, thanks largely to the efforts of the association, both teachers and examiners are beginning to realise that geography must be approached in the spirit of practical inquiry if it is to be of any value as a school subject Ordnance Survey maps can now be obtained by schools at greatly reduced prices upon application to the Director General of the Ordnance Survey Southampton, and suitable maps to supplement these will no doubt be suggested by the committee appointed by the association to consider the substance and scope of atlases for elementary schools A special committee on lantern-slides has also been appointed This committee hopes to prepare series of slides illustrative of certain aspects of geography, as well as of various countries It is specially anxious to obtain sets of views of different districts in the United Kingdom illustrative of their scenery and social conditions, as well as from British and other lands beyond the seas Such illustrations, combined with exercises on the construction and use of maps, practical measurements with tape and plane-table, meteorological observations recorded day by day, and the spirit of "Seek and ye shall find" permeating the whole of the work, will transform geography from a dismal study into a living science by which both the imaginative and the critical faculties may be cultivated We have no sympathy with the old order of things, but the change which the Geographical Association is bringing about gives decided satisfaction

THE provisional programme of the Federal Conference on Education, organised by the League of the Empire, and to be held in London from May 24 to June 1, includes the following educational subjects —Teachers (1) comparison of (*a*) the provisions for the supply and the training of elementary teachers, and of (*b*) the conditions of their work in the United Kingdom and other countries of the Empire and Crown colonies, (2) similar comparison in the case of secondary teachers, (3) practicability of temporary interchange of teachers and of inspectors between the United Kingdom and other countries of the Empire and Crown colonies The relations between secondary and primary schools in the various countries of the Empire Means of establishing a system of mutual recognition of equivalent standards of attainment in the several countries of the Empire in connection with primary, secondary, and university education Cooperation in educational publications (1) scheme of the League of the Empire for Imperial text-books in history, (2) means for ensuring correctness in text-books dealing with geography, or in which local knowledge is required Cooperation in school work (1) the formation of a central exhibition of industrial or other school work, (2) the organisation of the exchange of school work and specimens between departments, museums, and between individual schools on a permanent basis School subjects (1) the English language (*a*) reading (literature), (*b*) composition (*c*) pronunciation, (2) geography in its relations to (*a*) history (*b*) discovery and commerce, (*c*) the growth of the Empire, illustrated by lantern slides and other means (3) encouragement of nature-study Education of non-British races comparison of ideals methods and standards in various parts of the Empire Other subjects which may be discussed if time allows (*a*) cadet corps and military training, (*b*) educational facilities in sparsely populated districts, (*c*) educational treatment of poor law and reformatory children (*d*) civic and moral education (*e*) metric system of weights and measures, (*f*) school gardens

SOCIETIES AND ACADEMIES.

LONDON

Mineralogical Society, January 29 —Prof H A Miers, F R S, president, in the chair —Experiments bearing on the order of crystallisation of rock-constituents Prof H A **Miers**. The general results of experiments made by Miss F Isaac and Prof Miers with mixtures of salol and betol in all proportions were described, the experiments have established the supersolubility curves even beyond the points where they cross below the eutectic temperature Owing to the fact that the main separation of crystals in the cooling mixtures takes place only when the liquids have been supercooled to temperatures given by the supersolubility curves, it has been found (1) that in general the mixtures do not solidify as a eutectic mixture, (2) that, according to the conditions of supercooling either substance could be made to crystallise before the other in mixtures approaching the eutectic in composition It was suggested that these results are applicable to the solidification of many rocks and alloys —Serpentine rock

from the Larnthaler Kopfe, Tyrol Dr A P **Young** The minerals found in the serpentine are diopside, tremolite, clinochlore, picotite, magnetite, iron pyrites, and a fibrous mineral referred to antigorite The latter mineral is regarded as holding a place between the micas and chlorites On the surface of the serpentine are projecting bastite pseudomorphs coated with films of silvery lustre The serpentine is a non-foliated intrusive core which on the borders is highly foliated and passes into talc bearing phyllites A simple tabular arrangement of the thirty two crystallographic classes Dr J W **Evans.** The table is based on the character of the symmetry of the principal zone axis or zone axes Each column contains classes with the same rotational symmetry round the axis, and each row those which agree in the other symmetrical characters of the axis A new model of crystal refractometer Dr G T Herbert **Smith** This instrument is identical in principle with that previously described and is intended for use with large mineral specimens and mounted gem stones No part extends above the level of the plate holding the dense glass hemisphere Further the optical combination has double the focal length of the earlier form and provides consequently, greater refinement —Isomorphism as illustrated by certain varieties of magnetite Prof B J **Harrington** Analyses are given of specimens of magnetite from St Joseph du Lac, Canada, and from Magnet Cove, Arkansas, both showing the unusual combination of octahedron and trapezohedron {311} The Canadian specimen contained about 5 per cent of TiO_2 8 per cent of MnO, and 3 per cent of MgO and the specimen from Arkansas about 10 per cent of Al_2O_3, 2 per cent of TiO_2 2 per cent of MnO and 0 per cent of MgO —Mr **Fleischmann** exhibited a collection of zeolites from Japan, Dr **Evans** an objective giving a flat field with convergent light and Prof **Miers** a goniometer to be used for the measurement of the refractive indices of cooling solutions for which purpose it is provided with means for maintaining a constant temperature for any desired period

Zoological Society February 5 —H G the Duke of Bedford K G, president in the chair —Mammals collected in Mindanao Philippines, by Mr M P Anderson for the Duke of Bedford's exploration of eastern Asia O **Thomas** Seven species were mentioned, one of which was new and is designated *Crunomys melanius* sp n The origin of the lateral horns of the giraffe in fœtal life on the area of the parietal bones Prof E Ray **Lankester** The author described and showed the exact relation of the lateral horns in the fœtus taken from the giraffe which died last spring in the society's gardens It was demonstrated that the lateral horn of the giraffe was exclusively in origin a part of the fibrous osteogenetic tissue of the parietal bone of which it was a part and had no connection whatever with the frontal Thus the statement made by Sir Richard Owen in his account of a new born giraffe, in a paper read before the society in 1839 was finally shown to be based on an unfortunate accident Owen had cut out the horn-bearing area of the skull, and after an interval of time had reversed the relations of the excised piece of bone, taking frontal for parietal and parietal for frontal The author expressed the opinion that the *parietal* lateral horn of the giraffe could not be considered to be the same morphological unit as the frontal lateral horn of the okapi —Parallel hair fringes and colour striping on the face of fœtal and adult giraffes Prof E Ray **Lankester** The author described a remarkable colour banding or striping of the hairy covering of the face in the fœtal giraffe and showed that similar dark and light striping occurred in a very marked form in adult giraffes though not in all individuals —The existence of rudimentary antlers in the okapi, Prof E Ray **Lankester** A description was given of the polished tip or apex of the okapi's horn which breaks through the integument The author showed that transverse fissures or incisions were produced one behind the other in the naked apex tending to cut off in succession a series of small bony caps, which he regarded as rudimentary antlers He expressly refrained from concluding that this formation of minute antler-caps was to be regarded as genetically connected with the antler formation of the Cervidæ, though such a connection was possible —A new Amazonian tree-frog, *Hyla resinifictrix*, closely related to *H venulosa*, but distinguished by fully half-webbed fingers G A Boulenger, on behalf of Dr E A **Goeldi** This frog was remarkable for its habit of making good-sized basins of resinous substances in hollow branches of high trees, in which water collects, which served as a nursery for the eggs and larvæ The frog collected the resin from the bark of certain trees, such as the aromatic brewbranco" (*Protium heptaphyllum*) —The collection of Cumacea in the Copenhagen Museum Dr W. T **Calman** Altogether thirty species were dealt with, of which twenty-five were described as new The majority of the specimens were derived from collections made in New Zealand and the Gulf of Siam by Mr H Suter and Dr Th Mortensen respectively

Chemical Society, February 7 —Prof R Meldola, F R S, president, in the chair —The rapid electro-analytical deposition and separation of metals, part 1, the metals of the silver and copper groups and zinc H J S **Sand.** The metals studied are silver, mercury, copper, bismuth, lead, cadmium, and zinc With the exception of the separation silver-mercury, each metal has been successfully separated from all the others by the method of graded potential In order to separate silver from mercury, the metals were deposited together, converted into their cyanides, and these separated in the usual way by means of their different behaviour to acids The time required for the depositions in these experiments varied between five and fifteen minutes —The alkaloids of ergot G **Barger** and F H **Carr** It is shown that ergotoxine, $C_{35}H_{41}O_6N_5$, is the active principle of ergot, and Kraft's assertion that the crystalline alkaloid ergotinine, is a dehydrated ergotoxine is confirmed Ergotinine is physiologically inactive when pure —Influence of substitution on the formation of diazoamines and amino azo-compounds, part vi the partially methylated 4 6-diamino-*m* xylenes G T **Morgan** and Miss F M G **Micklethwait.** The authors have methylated progressively 4 6-diamino *m* xylene, and have studied the action of diazonium salts on the products —The constitution of umbellulone, part ii, the reduction of umbellulonic acid F **Tutin** By further study of the oxidation products of this ketone further confirmation of the constitutional formula originally assigned to it has been obtained —The reduction of hydroxylamino dihydroumbellulonoxime F **Tutin** Derivatives of aminotetrahydroumbellulylamine obtained by the reduction of this oxime are described Studies on optically active carbimides, part v the aryl esters and the amides of *l* menthylcarbamic acid R H **Pickard** and W O **Littlebury** Eleven aryl esters and eighteen amides of *l* menthylcarbamic acid were described, and rotations of these when dissolved in chloroform and pyridine compared Attention was directed to the approximately constant molecular rotation given by certain derivatives of menthylamine and menthol —Some constituents of natural indigo, part i A G **Perkin** and W P **Bloxam** Three brown amorphous substances $C_{14}H_{12}O_2N_2$, $C_{24}H_{22}O_6N_4$, and $C_{16}H_{14}O_4N_2$ are described, which on treatment with potassium hydroxide yield anthranilic acid It is considered possible that these brown compounds are derivatives or condensation products of indoxyl which are formed from indican during the process of manufacture —The occurrence of isatin in some samples of Java indigo A G **Perkin** The quantity of isatin present was exceedingly small, and in many samples it appeared to be absent but its occurrence occasionally is interesting, as it indicates that the formation of indirubin during the manufacture of natural indigo follows the well-known synthesis of von Baeyer —The absorption spectra of benzoic acid, the benzoates, and benzamide W N **Hartley** and E P **Hedley** The absorption curves of benzoic acid, potassium and silver benzoates and benzamide have been drawn from the photographs of the spectra of these substances The absorption bands of the different substances are all obviously related to the bands in benzoic acid, and the absorption is due to the benzene ring (compare Baly and Collie Trans Chem Soc, 1905 lxxxvii 1332) —The absorption spectra of phthalic isophthalic, and terephthalic acids, phthalic anhydride, and phthalimide

W N **Hartley** and E P **Hedley** *o*-Phthalic acid gives an absorption curve of the character that might be expected from a comparison with that of benzoic acid *iso*Phthalic acid has a shallow band in the same position as that of phthalic acid, but less persistent Terephthalic acid has no band, but merely an extension at or near where a band might be expected—ααγ-Trimethyl- and ααγγ-tetramethyl-tricarballylic acids and αδ-dimethylbutane-αβδ-tricarboxylic acid H **Henstock** and C H G **Sprankling.**—A reaction of certain colouring matters of the oxazine series J F **Thorpe**—The alkylation of *d*-fructose T **Purdie** and D McLaren **Paul** The series of derivatives of fructose obtained by methylating this ketose is described—A simple apparatus, with stirrer, for treating a liquid at its boiling point with two or more gases N L **Gebhard.**—Note on the arsenates of lead and calcium S **Pickering**—Camphor-β-sulphinic acid and camphorylsulphonium bases S **Smiles** and T P **Hilditch.** The sulphinic acid and the sulphonium bases prepared exhibit a strong lævorotatory power in distinction from the dextrorotatory sulphonic acid from which they were obtained The authors conclude that this change is caused by the conversion of the sulphur from the sexavalent to the quadrivalent state—The condensation of salicylamide with aryl aldehydes C A **Keane** and W W S **Nicholls** Benzaldehyde, when heated with salicylamide in presence of hydrochloric acid or of sodium acetate, condenses to form a cyclic compound of the oxazine group, namely, 2-phenyl-1 3-benzoxazone Homologues of this were prepared by condensing salicylamide with anisaldehyde and *o*-methoxybenzamide with benzaldehyde—The condensation of diethylmalonamide with aldehydes H **Burrows** and C A **Keane** Diethylmalonamide, when heated with benzaldehyde in presence of hydrochloric acid, condenses similarly to salicylamide (see note on preceding paper) to form a cyclic compound of the pyrimidine group, 4 6-diketo-2 phenyl 5 5-diethyl hexahydropyrimidine

Mathematical Society, February 14—Sir W D Niven, vice-president, in the chair—Prof A R **Forsyth** gave an account of the life and scientific work of the late Colonel A Mannheim an honorary foreign member of the society—Repeated integrals Dr E W **Hobson** When Riemann's definition of integration is adopted, it may happen that the double integral of a function does not exist, although the repeated integral does exist if the integrations are performed in a certain order The more extended definition of integration introduced by Lebesgue throws light on this and other anomalies in the theory of the relations of double integrals to repeated integrals The projective geometry of a binary quartic and its Hessian Prof E B **Elliott.** The quartic is regarded as the equation of four straight lines drawn through the origin, and is represented by the four points in which these lines meet a chosen conic drawn through the origin The original quartic and its Hessian are members of a pencil of quartics, each represented by four points on the conic, and all the quadrangles which are thus obtained have the same harmonic triangle Any quadrangle of the set is determined by the harmonic triangle and one vertex of the quadrangle With this vertex a certain point on a chosen side of the harmonic triangle can be associated by a linear construction, and the quadrangle is determined by this point and the harmonic triangle The determining point for the Hessian can be associated with that for the original quartic by a linear construction which is given in the paper—A formula for the sum of a finite number of terms of the hypergeometric series when the fourth element is equal to unity Prof M J M **Hill** The formula includes the well-known expression for the sum of the series, and gives an exact value for the remainder after *s* terms—Groups defined by the order of two generators and the order of their commutator Prof G A **Miller**—An informal communication on hyper exponential numbers was made by Lieut-Colonel A **Cunningham**

DUBLIN

Royal Irish Academy, January 14—Dr F A Tarleton, president, in the chair—Infection of bovines by the avian tubercle bacillus Prof **Mettam** The paper gave an account of experiments with cultures of avian tubercle bacillus Injected into the auricular vein of a heifer, the virus produced a fatal infection In the other experiment a portion of a culture was given by the stomach-pump to a young bull The animal became infected as shown by the tuberculin test It recovered from the infection, however, because just prior to slaughter the animal was re-tested, but did not respond, and the lesions found at *post mortem* were sterile, and failed to produce a lesion in the rabbit in which they were inoculated Both animals were shown to be free from tuberculosis prior to experiment by the use of tuberculin The same author also read a note upon the development of tubercles in the lacteals of the villi of the small intestine in rabbits infected by feeding with tuberculous material from a bovine source The tubercle has the same anatomical structure as that developing in the pulmonary capillaries or liver sinusoids—epitheloid cells of mononuclear leucocyte origin, lymphocytes, and giant cells The epithelium of the villus may be intact—The general solution in integers of the indeterminate equation $aX^3+bY^3+cZ^3+dXYZ=0$ Dr T **Stuart.** The solution of this equation (or of special cases of it) has been considered by Sylvester, Lucas, Desboves, and other writers The only known method (save that of trial) for finding a solution is by means of artificially constructed identities In this paper the various identities and theorems obtained by previous writers are coordinated and shown to be deducible from elementary geometrical considerations, and some statements of Sylvester and Desboves are also shown to require considerable modification The geometrical method of attacking the problem leads to important results in high factorisation

January 28 The river Shannon its present regimen and geological history J R **Kilroe** The river admits of easy navigation falling only about 150 feet in 140 miles It commenced to flow upon a plain of post-Eocene date 2500 feet to 3000 feet above present datum and a very trifling inclination to the north west or south would have permanently deflected the drainage Retention of its course alone could have kept the gorge at Killaloe open but at some time shortly prior to the Glacial epoch the river seems to have abandoned the gorge until the ancient bed by Killaloe was lowered at certain points below the sea-level by glacier erosion Upon the disappearance of the ice the river resumed its original course

PARIS

Academy of Sciences, February 11—M A Chauveau in the chair—The preparation of alkylcampholic esters and on a new method of formation of phenyloxyhomocampholic acid A **Haller** and Charles **Weimann** The cyanocampholic esters treated with alkyl magnesium iodides yield imido-compounds, the latter with sulphuric acid, giving ketones The cyanogen group of the cyanocampholic ester is here replaced by the group —COR, R being the alkyl group of the magnesium compound Numerous examples of the application of this reaction are given—The mechanism of the transformations in normal media of the Crustaceæ E L **Bouvier** At the commencement of the Quaternary epoch the formation of the Isthmus of Panama caused a separation of the crustaceans in this region and each group has developed in a normal medium since that time Typical species are compared to show the amount of the differences which have arisen during this period—Has the African elephant a pleural cavity? Alfred **Giard** The *post-mortem* examination of an African elephant, recently described by Mme M Phisalix, would appear to show that the African elephant has a pleural cavity In the case of the Asiatic elephant there is clear evidence that the visceral and parietal layers of the pleura are closely connected together by matted elastic tissue and it is highly probable that this is also the case in the African elephant The diagnosis of pleurisy on account of thickness of the pleura and its adherences would, therefore appear to be a mistaken one—Various syntheses of dimethylisopropyl-carbinol Louis **Henry** The α-chloro-*iso*butyric aldehyde reacting with magnesium methyl bromide gives the expected pinacolic alcohol but its tertiary isomer, dimethyl*iso*propyl carbinol A theory of this reaction, supported by experimental facts is proposed—Observations of the sun made at the Observatory of Lyons during the fourth quarter of 1906 J

Guillaume The results are summarised in three tables showing the number of spots, their distribution in latitude and the distribution of the faculæ in latitude.—The problem of Dirichlet H **Lebesgue**—The non applicability of two continuous regions of n and $n+p$ dimensions René **Baire**—The channelled spectra of parallel gratings Georges **Meslin** A mathematical discussion of the various hypotheses which have been proposed in this connection, and in particular that due to M Garbe whose theory is shown to give a complete explanation of the phenomena —A singular state of matter observed in a dissolved chromic salt Albert **Colson**—The alkylation of metallic cyanides H **Guillemard**—The catalytic reduction of unsaturated ethyl esters G **Darzens** An application of the Sabatier and Senderens reaction to the preparation of ethyl propionate isovalerate, and pelargonate from the corresponding unsaturated esters The addition of two atoms of hydrogen to a whole series of acids of the type $R(CH_2)C\ CHCO_2H$ a general method for the preparation of which is described can also be effected in this way Examples of the application of the method in the aromatic and hydroaromatic series are also given —The transformation of primary saturated alcohols into the corresponding monobasic acids H **Fournier** Alkaline permanganate has been shown to give oxalic acid with some primary alcohols The author shows that if the conditions prescribed by him are followed, a yield of acid amounting to 75 per cent of the theoretical can be obtained —The presence of aldehydes in cheese and the part played by them in the formation of bitterness A **Trillat** and M **Sauton** Experiments are given establishing the presence of aldehydes in cheese and also the existence of a relation between the quantity of aldehydes and the bitterness of the cheese —Alternating currents of varying periods corresponding to musical sounds the physiological effects of rhythmic alternating currents Maurice **Dupont**—Remarks on the preceding paper by M **d'Arsonval**—Some phenomena of biological adaptation by rhythmical anticipation H **Piéron**—Ether anæsthesia parallel with chloroform anæsthesia Maurice **Nicloux** A quantitative study of the distribution of ether in various organs of the body during anæsthesia These quantities are greater with ether than with chloroform, and the ether is eliminated more rapidly —Lymphosarcoma in the dog A **Borrel**—The discovery of the marine Aquitanian in the middle part of the Rhone valley L **Joleaud**—Some geothermal measurements effected in the Pas-de-Calais basin Félix **Leprince Ringuet.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 21

ROYAL SOCIETY, at 4 30 — The Estimation of Chloroform in the Blood of Anæsthetised Animals G A Buckmaster and J A Gardner —On Electrical Seed Testing Prof T Johnson —On Longitudinal Symmetry in Phanerogamia Prof Percy Groom —On the Inheritance of Flower Colour in *Antirrhinum majus* Miss M Wheldale

ROYAL INSTITUTION at 3.—The Minute Structure of Igneous Rocks and their Significance Alfred Harker, F R S

CHEMICAL SOCIETY at 8 30 —The Constitution of Oxyazo-compounds W B Tuck —The Influence of Solvents on the Rotation of Optically Active Compounds, Part ix , A New General Method for Studying Intra molecular Change T S Patterson and A McMillan —The Reduction Products of ortho and para Dimethoxybenzoin J C Irvine and A M Moodie —Replacement of Halogens by Hydroxyl, i , The Hydrolytic Decomposition of Hydrogen and Sodium Monochloroacetates by Water and by Alkali and the Influence of Neutral Salts on the Reaction Velocities G Senter —The Reaction of Ammonium Salts with the Constituents of the Soil A D Hall and C T Gimingham

LINNEAN SOCIETY at 8 —The Percy Sladen Trust Expedition to the Indian Ocean Introduction, Part 1, Ceylon to Mauritius J Stanley Gardiner —Land Nemerteans with a Note on the Distribution of the Group R C Punnett —Land Crustaceans L A Borradaile —Hymenoptera P Cameron —Dragon Flies F F Laidlaw —Fourmis des Seychelles, Admirantes Farquhar et Chagos Prof A Forel —Pycnogonidæ G H Carpenter

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Lecture on "Modern Theory of Conduction of Electricity in Metals Prof J J Thomson, F R S

FRIDAY, FEBRUARY 22

ROYAL INSTITUTION, at 9 —Flame in Gas and Petrol Motors Dugald Clerk

PHYSICAL SOCIETY, at 5 —Transformer Indicator Diagrams Prof Lyle —Ionisation of Gases by a Particles of Radium Prof Bragg —A Micro manometer B Roberts

INSTITUTION OF CIVIL ENGINEERS, at 8 —Impurities in Boiler Feed water, their Nature, Effect and Elimination F E Walker

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3 —Röntgen, Kathode, and Positive Rays Prof J J Thomson, F R S

THE ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6 30.—Notes on Dr Fletcher's Report on the Sanitary Circumstances of the Village of Coggleshall T V Holmes —Botanical Surveying in Brittany, an Account of Ecological Work on the Bouche d'Erquy. T G Hill

MONDAY, FEBRUARY 25

ROYAL GEOGRAPHICAL SOCIETY, at 8 30 —Inland Waterways G. G. Chisholm.

INSTITUTE OF ACTUARIES, at 5 —Comparative Bonuses under Whole Life and Endowment Assurances H J Rietschel.

TUESDAY, FEBRUARY 26

ROYAL INSTITUTION at 3 —The Visual Apparatus of Man and Animals: Prof William Stirling

INSTITUTION OF CIVIL ENGINEERS, at 8 —On the Limits of Thermal Efficiency in Internal Combustion Motors: Dugald Clerk

WEDNESDAY, FEBRUARY 27

GEOLOGICAL SOCIETY, at 8 —On the Lower Ordovician Succession in Scandinavia W. G Fearnsides —The Occurrence of Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine, Witwatersrand C. Baring Horwood

SOCIETY OF ARTS, at 8 —Modern Type-writers and Accessories Arthur E Morton

THURSDAY, FEBRUARY 28

ROYAL SOCIETY, at 4.30 —*Probable Papers* On the Dispersion in Artificial Double Refraction L. N G Filon —The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes A. A Campbell Swinton.—The Theory of Correlation for any Number of Variables, treated by a New System of Notation G Udny Yule

SATURDAY, MARCH 2

ROYAL INSTITUTION, at 3 —Röntgen, Kathode, and Positive Rays Prof. J J Thomson, F R S

CONTENTS.

THURSDAY, FEBRUARY 28, 1907

SCHOOL MATHEMATICS

(1) *Trigonometry for Beginners* By J W. Mercer Pp. xi+351 (Cambridge University Press, 1906) Price 4s

(2) *Trigonometry for Beginners* By Rev J B Lock and J. M Child Pp vii+195 (London · Macmillan and Co, Ltd, 1906) Price 2s 6d

(3) *Geometry an Elementary Treatise on the Theory and Practice of Euclid* By S O Andrew Revised edition Pp xii+218 (London John Murray, 1906.) Price 2s

(4) *Modern Commercial Arithmetic* Part 1 By G. H Douglas Pp. 163 (London. Macmillan and Co, Ltd, 1906) Price 1s 6d

(5) *A New Shilling Arithmetic* By C Pendlebury, assisted by F E Robinson Pp xii+176+xxxiv (London · George Bell and Sons, 1906) Price, with answers, 1s 4d

(6) *Junior Arithmetic Examples* By W G Borchardt Pp viii+171+xl (London Rivingtons, 1906.) Price 1s 6d

(7) *Clive's New Shilling Arithmetic* Edited by Dr W Briggs Pp viii+160. (London W B Clive, University Tutorial Press, Ltd, 1906) Price 1s

(8) *Junior Practical Mathematics* By W J Stainer Pp x+350 (London George Bell and Sons, 1906) Price 3s.

(9) *A Rhythmic Approach to Mathematics* By Edith L. Somervell, with a preface by Mary Everest Boole Pp 67 (London George Philip and Son, Ltd, 1906) Price 2s 6d net

(1) MR MERCER possesses a fine conception of how trigonometry should be presented to youths, and his book is admirable and altogether good The development of the subject is very gradual indeed and is constantly enforced by means of concrete examples, systematic computations, practical geometry, and by judicious graphs Thus the first ten chapters are confined to the development of the simple trigonometrical ratios, that is, to the solution and application of right-angled triangles, under all sorts of conditions, such as in problems of elementary surveying, the resolution of vectors, areas, solutions of triangles in general, &c, and later on additional illustrations of right-angled triangles occur in the chapter on traverse tables Four-figure mathematical tables, including logarithms, are in constant use, and careful attention is paid to arrangement and checking of the numerical work After this thorough grounding, angles of any magnitude are introduced, and triangles are solved by general formulæ, a useful table of log haversines being here provided Then the radian measure of an angle is explained, and the treatment becomes more abstract, the final chapters dealing with multiple and submultiple angles, transformation formulæ, identities, equations, and inverse notation. Finally, there are two hundred miscellaneous examples grouped in sets of five, and collected answers to the very numerous exercises distributed throughout the book The author is to be congratulated on having produced a very notable text-book on elementary trigonometry, and one that is worthy of adoption in the secondary, technical, and public schools throughout the country

(2) Messrs Lock and Child, like the author just noticed, start with the very laudable idea of presenting the subject in a more practical and less abstract form than is commonly met with, and they are successful, though not to the same extent as in the previous case Their development of the subject is not so finely graduated, they have not sufficiently recognised the fundamental importance of the right-angled triangle, and their special five-figure tables, without differences, though compact, become tedious in use and necessitate undue attention being given to the theory of proportional parts, a side issue The opening chapters of the book are geometrical, and contain descriptions of practical methods of measuring angles, both of azimuth and of elevation, a detailed description of the sextant and theodolite being reserved for a later chapter Suitable exercises and test papers are provided at intervals, and the work concludes with answers and an index The book contains many good features, and can be recommended especially to students preparing for the examination of the Board of Education in mathematics, stage 2

(3) As the result of increased experience, and also to meet the requirements of examiners, the subject-matter of Mr Andrew's well-known "Geometry" has been re-arranged and added to, while preserving the excellent features of the original work Thus the first seven chapters are mainly experimental, practical, and quantitative, and with the "intimate first-hand knowledge" of geometry thus obtained the learner is well prepared for the theoretical work of the next chapter, in which formal proofs are given, arranged in logical sequence The deductive method is employed in subsequent work, which deals with similar figures, the solution of triangles solid geometry and projection, and the mensuration of geometrical solids The plan and scope of the book are excellent, and in its revised form the manual will deservedly appeal to an increasing number of readers

(4) The "Commercial Arithmetic" by Mr Douglas is a very interesting work Assuming the student to possess a knowledge of the fundamental rules of arithmetic, the author begins with examples of the tabular arrangement of numbers, with checks labour-saving devices, and contracted and approximate methods in addition, subtraction multiplication and division, and with the decimalisation of money In the chapter on the calculation of prices we find some very neat methods of working For example, since $365=240+120+5$, we have 365 at, say, 8d each $=$ 8l + 4l + 3s 4d = 12l 3s 4d In dealing with percentages, commission, discount, and profit and loss, examples of commercial book-keeping are given, and there is the same regard for special and rapid methods of computation In the calculation of simple interest for a specified number of years and days, an ingenious method known as the "third, tenth, tenth" is much used The table given on p 88 for finding the

number of days between any two dates would be improved by a grouping of the rows. Subsequent chapters deal with compound interest, various kinds of discount, bills of exchange, shares, mixtures, and with examples involving general tables of weights and measures, English and French. Collected answers are given at the end, and altogether the book is very cleverly written, and seems eminently suited for use on the commercial side of the numerous technical and secondary schools of the country.

(5) This book is practically the authors' "Junior Arithmetic," with the chapters on the first four rules replaced by sets of examples for revision. It is intended for the middle and lower forms of secondary schools and is specially adapted to the requirements of the Oxford, Cambridge, and Scotch local examinations and the like. The explanations of the rules are condensed, and the book contains a very large collection of examples, and is printed both with and without answers.

(6) The volume by Mr. Borchardt is based on the author's "Arithmetical Types and Examples," but with many additions, the explanations and statements of the rules are left entirely to the teacher, the sets of examples being well chosen and carefully grouped. The book is suitable for use under conditions similar to those stated under No. 5.

(7) Clive's "New Shilling Arithmetic" is mainly a collection of exercises and problems, with such statements and definitions of rules as a pupil might profitably commit to memory. It covers largely the same ground as the two previous books, all three having been much influenced by the recent reforms in mathematical teaching. The book can be had with answers at a small extra cost.

(8) The "Junior Practical Mathematics" is intended for use in preparatory and public elementary schools and in the lower forms of secondary schools. The book is divided into two parts, which may be obtained either separately or together, and with or without answers. Part i. is mainly arithmetical, but the numerical work is supplemented throughout by algebraical and graphical work. This part contains, amongst other things, the four simple rules, practice, brackets, areas, volumes and weights, graphs, fractions, indices, logarithms, proportion, percentages, interest, approximations, and contracted methods. Part ii., which is chiefly geometrical, includes elementary plane geometry, orthographic projection and descriptive geometry, and some mensuration. In both parts the sequence is unusual, and seems somewhat erratic. The book is well supplied with a good variety of examples and exercises.

(9) The preface to this suggestive book is written by Mrs. Boole, who is the originator of the method described in its pages, a system which well deserves the sympathetic consideration of educational reformers. The leading idea is, working on untutored minds, to find "a means of introducing little children to the conception of a connection between organic thought-sequence and the evolution of harmonious form." The means employed is simple embroidery in coloured threads, by following some simple rule "a graceful curve such as he has perhaps never before seen or imagined, grows up under his hands, as if by miracle." One such is the curve of pursuit. The method has been successfully carried out by Mrs. Somervell and others, and has developed into a system of geometrical design which Mrs. Boole unhesitatingly believes "is a working possibility as a means of truly national evocation of creative and organising power." In order to encourage the spread of the system sets of curve-sewing apparatus have been designed, and can be procured at a moderate cost.

THE ZOOLOGIST AND SPORTSMAN IN BRITISH COLUMBIA

Camp-fires in the Canadian Rockies. By Dr. William T. Hornaday. Pp. xvii+353; illustrated. (London: T. Werner Laurie, 1906.) Price 16s. net.

MOST sporting books leave the distasteful impression that the hunter's main interest in wild animals is that they are something to kill—the bigger the better. But this book shows us a hunter who, though ardent in the chase and glowing with its barbaric excitement and triumphs, has yet a conscience in his slaying, and can, on occasion, find as keen pleasure in stalking without intent to kill, but only to observe and picture. So that while the sporting man will find in the book a sufficient spice of hunting incident and success to stir the savage emotion, the less bloodthirsty reader also will find satisfaction in the moderation of this hunter and in his vivid presentment of the wild life of mountain and forest.

The book is the record of a recreative holiday trip made in the autumn of 1905 by Dr. Hornaday, the Director of the New York Zoological Park, under the guidance of his friend Mr. Phillips, Pennsylvania State Game Commissioner, to a hunter's paradise hidden away among the mountains of the south-eastern part of British Columbia, where, actually, on the first day of their coming, a band of mountain-goats stampeded through their very camp, almost upsetting the cook at his work!

Here, and at a later camp, with the tangled forests below them and the stony peaks above, they spent their thirty days in great content, readily securing the few picked specimens of mountain-goat and sheep for which they had come, having also the additional luck to add a grizzly bear apiece to their trophies, and thereafter enjoying splendid though somewhat hazardous sport in striving, with success, to "break record" in photographing their live game at close and still closer quarters among the precipices. Of these days in the "home of the mountain-goat" two only were given to hunting goats to shoot them.

"We saw two hundred and thirty-nine individuals. . . . It was because we shot little that we saw much."

Here is a charming picture of the kind of thing they saw:—

"Rising into view out of a little depression on the farther side of the meadow, lazily sauntering along, there came ten big, snow-white billy goats!

The air was clear, the sun was shining brightly, the meadow was like dark olive-brown plush,—and how grandly those big pure-white creatures did loom up!

For more than an hour we lay flat on our pinnacle, and watched those goats. They were more than deliberate, they were almost stagnant. They were already so well fed that they merely minced at the green things around them. Each one seemed steeped and sodden in laziness. When out grazing, our giant tortoises move faster than they did on that lazy afternoon. When the leader of this band of weary Willies reached the geographical centre of the sky-meadow, about two hundred yards from us, he decided to take a sun-bath, on the most luxurious basis possible to him. Slowly he focussed his mind upon a level bench of earth, about four feet wide. It contained an old goat-bed, of loose earth, and upon this he lay down, with his back uphill. Five minutes later a little higher up the slope, another goat did the same thing, and eventually two or three others laid down. One, however, deliberately sat down on his haunches, dog-fashion, with his back uphill. For fully a quarter of an hour he sat there in profile, slowly turning his head from side to side, and gazing at the scenery while the wind blew through his whiskers" (pp. 82–4).

Mr. Phillips's photographs of the mountain-goat at close quarters, obtained at such desperate hazard, are admirable, but, after all, he cannot give us that touch of mountain breeze through the lazy Billy's whiskers! And what a pity that such a restful holiday-picture should be spoilt by the crack of a rifle!

Dr. Hornaday's first care in this volume is for the mountain-goat (he scorns the term "antelope-goat" as being affected and incorrect), and next for the mountain sheep and the grizzly bear, but he finds room also for the small neighbours of the big game—the wolverine, pine marten, coyote, pika, ground-squirrel, pack-rat, and others—all depicted with the same sympathetic and vivid touch, and generally with authoritative notes upon their geographic range and novel observations on their habits, and the birds of the region, too, receive a share of his careful notice.

The author deplores the practical extinction of wild life in the Western States, and calls upon the Canadian authorities to do what his own Government has failed to do—stringently to preserve the remnants. He considers that the British Columbian game laws err in being too liberal in every particular, and pleads for the absolute protection of all female game animals and for a reduction of the number of head allowed under each shooting license. Even the grizzly bear should, in his opinion, be protected, and he thinks that, with proper care, the Canadian Rockies might continue almost indefinitely to be the Delectable Mountains of the vigorous sportsman. The attempts that are being made toward this end should be of interest to the student of sociology, who may here watch the development of game laws anew in a democratic community.

To the splendid photographs with which the book is illustrated, and to the sensational circumstances in which some of them were obtained, we have already referred. Both astonishing and amusing is the account given by Mr. Phillips of how, during one of these operations, while on a dangerous rock-ledge from which he could not retreat, he was charged by an angry goat:—

"There was really nothing that I could do except to hold the [stereoscopic] camera at him and snap it. He charged up to within a yard of me, but with his eyes fixed on the two lenses. Then he appeared to conclude that any animal that could stand that much without winking was too much for him, so shaking his head and gritting his teeth he stopped, and to my great relief slowly backed into his niche" (p. 190).

No wonder that the resultant photograph is a "record"!

That the trip was one that any zoologist must have enjoyed goes without saying, and we thank Dr. Hornaday heartily for this delightfully written record of his own pleasure in it. Indeed, perhaps the chief charm of the book is that he manages so faithfully to convey a sense of the recrudescence of boyish energy and spirits in staid middle life, aroused under the stimulus of unusual and invigorating surroundings, for is not the enthusiasm of middle-life more contagious than that of youth itself? So let us all echo, for him, his own farewell wish:—

"May heaven keep my memory of it all as fresh as the breezes that blow on Goat Pass, as green as the pines and spruces that clothe the lower slopes of those delectable mountains"! G. W. L.

A BOOK ON CLAYS

Clays, their Occurrence, Properties, and Uses, with Especial Reference to those of the United States. By Dr. Heinrich Ries. Pp. xvi+490. Illustrated. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 21s. net.

"DOUBTLESS few people realise the importance of the clay working industry in the United States, and yet this is not so surprising since clay has less popular attraction than many other mineral products, such as gold, silver, &c. A casual glance, however, at the annual figures of production will probably speedily convince one that clay is to be classed among the foremost products of the country, being outranked only by coal and iron."

In 1904 the value of the clay products of the United States was 26,204,650*l.*, while the raw clay, mined and sold within the States, amounted to 464,030*l.* Not so long ago America was more backward than Europe in the attention she paid to her clay resources. This has now been changed. In recent years we have witnessed the growth of a goodly crop of literature upon this subject in the United States, both in official publications and in occasional papers. The crop has been a heavy one in more senses than one, and bulky withal, and few there are, even in America, whose shelves could afford it space. It should be therefore a matter for congratulation to all American clay-workers that for the sum of five dollars they may now obtain in convenient form—the selected fruit—that which they had already received gratis in great volume. Although the possessors of the numerous

State Reports will be familiar with the style and most of the matter of this book, it is an undoubted advantage to have the information within reasonable compass

But Dr Ries has not merely produced a condensed epitome of earlier publications, he has prepared a well-balanced, thoroughly practical work on American clays and clay-products, including a capital summary of our knowledge of the properties of clays in general The whole has been brought well up to date

The author treats his subject under the following heads —(1) The origin of clay, (2) chemical properties, (3) physical properties, (4) kinds of clay, (5) methods of mining and manufacture, (6) distribution of clay in the United States, (7) Fuller's earth

The distribution of the clays is considered under each State separately, according to the geological age of the formations, but an excellent index enables references to particular kinds of clay to be found readily

It may be remarked that we are still in the dark as to the cause of plasticity in clays, in spite of the numerous theories, nor has any generally applicable method of measuring this property been discovered Dr Ries discusses the subject with great fairness. We heartily commend his views upon the loose way in which kaolin and kaolinite are so often confused, and especially his objection to the assumption that kaolinite is the normal basis of *all* clays, a brief comparison of analyses at once dispels this idea

This book is very well produced and free from slips, but we are somewhat puzzled by the "increase in texture" mentioned on p 107

THE ÆTIOLOGY OF LEPROSY

On Leprosy and Fish Eating A Statement of Facts and Explanations By Jonathan Hutchinson F R C S, F R S Pp xxiv+420 (London Archibald Constable and Co, Ltd, 1906) Price 12s 6d net

THE object of this work is stated in the preface to be "to carry conviction to the reader that the fundamental cause of the malady known as true leprosy is the eating of fish in a state of commencing decomposition" The various districts in which leprosy occurs have been examined, and it is found that in practically all fish is consumed as an article of diet, often in a more or less stale condition, the prevalence of the disease frequently being in a direct ratio to the amount of fish eaten Mr Hutchinson would associate the former prevalence of leprosy in the British Isles and in Europe with the Roman Catholic ordinances prescribing fish-food on two out of every three week-days, its decline in these countries with the relaxation of discipline which preceded the Reformation, its extinction with the establishment of Protestantism

We think that Mr Hutchinson goes much too far in thus ascribing *all* variations in the prevalence of leprosy as being correlated with those of a fish-diet, even in the fact that the disease is more prevalent among men than among women he sees support for his hypothesis, for he suggests that women are more fastidious feeders than men, that men would be more likely than women to obtain fish if this were expensive, and so on Why fish fresh or properly salted does not convey the disease and only bad fish does is by no means clear, the single suggestion given being that there may be some connection between tuberculosis and leprosy, and that fish-diet may contain some constituent which may modify the tubercle bacillus and convert it into the leprosy bacillus! Mr Hutchinson maintains that the facts he has collected point to the conclusion that the efficient cause of leprosy must be some article of food (p 33), and that fish is the only one of universal occurrence which can be traced

But is it necessary to find a *single* mode of origin for the disease in every part of the world? Surely not, and if so there is no need to limit it to fish Mr Hutchinson admits that personal contact may convey the disease, but declares that this mode of infection is exceedingly rare, "where one had acquired the disease, hundreds equally exposed to risk had escaped" (p viii) But the latter statement proves little, all of us who live in big towns must daily come in contact with the virus of tuberculosis, yet only an unfortunate few contract the disease Similarly, as regards the decline of leprosy, most, if not all infective diseases show periods of epidemic prevalence and of decline, to what can be ascribed the disappearance of plague and of malaria from England? Mr Hutchinson says the world-wide distribution of leprosy proves that "it is not solely dependent upon contagion", this does not appear to mean personal contact, but to suggest an origin *de novo* Would not the same apply almost equally to tuberculosis, but would it be said that therefore the last-named disease is capable of "independent origination"? In the case of tuberculosis, often many years may in all probability intervene between infection and manifestation, in leprosy we do not know how long the virus may lie latent, and therefore an exposure long forgotten may really be the determining cause of the attack, without bringing in a *de novo* origin, in those rare cases in which it has not been possible to trace the source of infection

Lesions of the nasal mucous membrane are extremely frequent in lepers, and the nasal discharge may therefore be the chief vehicle by which the virus is disseminated It has also recently been reported that the mosquito and the bed-bug may harbour the bacillus, further channels again by which infection may be carried These, together with the close contact and promiscuous intercourse which exist between the members of native races, seem to us sufficient to explain the source of infection in leprosy, fish-diet being only a remarkable coincidence

In thus criticising Mr Hutchinson's theory we do not in the least desire to belittle his work, which is of the greatest interest, and his book is a valuable contribution to the epidemiology of leprosy,

OUR BOOK SHELF.

The Elements of the Science of Nutrition By Prof Graham Lusk Pp 326 (Philadelphia and London W B Saunders Co, 1906.) Price 12s net

PROF GRAHAM LUSK is to be congratulated on having produced a very interesting and important book The author is an investigator imbued with the true scientific spirit, and his work has always been characterised by thoroughness and sincerity The introductory chapter is a very lucid exposition, not only of the history of research on the subject of metabolism or nutrition, but it also gives an excellent summary of the nature of the problems to be attacked, and the main results hitherto obtained This chapter alone entitles the book to high distinction, but the subsequent chapters which fill in the details of the picture maintain the high standard of the beginning The reader will find here a mine of useful information, and will easily comprehend the facts in their relation to each other, so clearly and exhaustively are they dealt with

The English reader will be able to study for the first time in his own language the epoch-making work of Rubner, who has, among other points, directed attention to what he terms the specific dynamic value of the foodstuffs, fat outside the body is the most readily combustible of the proximate principles of food, and weight for weight yields more than twice the number of calories which proteids give rise to Fat has, of course, the same calorific value when it undergoes combustion within the body, but it is inferior to the proteins as a heat generator, because it is burnt with so great difficulty there The proteins are the most readily burnt of all the foodstuffs, and this property of stimulating metabolism constitutes their specific dynamic value In the discussion now in progress on the amount of protein food which is necessary, a question raised by the recent work of Chittenden and his colleagues, this factor is one which must not be lost sight of

The book not only deals with metabolism in health, but also in diseased conditions (gout, diabetes phosphorus poisoning, fever, &c) This makes the work very comprehensive, for it is just in these questions of nutrition that physiologists and pathologists may mutually learn so much by a correlation of their respective spheres of study In the chapter on diabetes, one notes the following sentences —

"No disease has been more thoroughly investigated In presenting the details to the reader, it may be remarked that the work done is prophetic of possible accomplishment along scientific lines in the study of disease It is typical of that scientific medicine which affrights the devoted spirits of a passing empiricism "

Prof Lusk evidently speaks with feeling, and has perhaps suffered from the passive resistance of the conservative "devoted spirits" to whom he alludes If anything will move them, it will be study of such books as the one we are dealing with

The book is very appropriately dedicated to Carl von Voit, the pioneer of such work, and the author's old master

W D H

Physical Chemistry for Electrical Engineers By J Livingston R Morgan Pp viii+230 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1906) Price 6s 6d net

THIS book has been written not only for the professional electrical engineer, but also for the use of those who desire to obtain a knowledge of physical chemistry sufficient in its scope for the understanding of current work in electrochemistry The subject-matter is divided into seven chapters, which treat respectively of fundamental principles, the general properties of gases, heat and its transformation into other forms of energy, solutions, chemical mechanics, equilibrium in electrolytes and electrochemistry An eighth chapter is devoted to a series of problems

In the method of presentation the standpoint of the now fashionable cult of "anti-atomists" has been adopted, the author's opinion being "that by placing the subject upon a purely experimental basis, giving a practical experimental definition of each concept as it is used and drawing no inference not justified in all its parts by actual results, the reader's idea will be the more clear and scientific " This is distinctly unfortunate, for nothing is gained by the non-recognition of the atomic and molecular hypotheses The services rendered by the hypothetical atom are too enormous for the concept to be discarded on purely pedantic grounds Apart from this, the detailed treatment of the subject-matter is good, and the chemical student will find the book interesting reading. It is scarcely to be expected, however, that its contents will be understood by the professional electrical engineer No doubt a knowledge of physical chemistry is essential for the engineer who would understand the working of storage batteries and the recent developments in electrochemical industry, but when the training of the electrical engineer in this country is considered, the possession of the chemical knowledge requisite for an intelligent reading of Prof Morgan's book is scarcely to be expected

H M D

The Technical College Set of Mathematical Instruments No 727 (London W H Harling) Price 2l 2s

THERE is great diversity of opinion as to the most suitable case of drawing instruments for students, many colleges having their own particular specifications, but it would be difficult to find a more desirable set of instruments than this of Mr Harling, on account both of the judgment displayed in the choice of the instruments and the design and workmanship exhibited In the neat pocket case will be found a 4-inch bow compass, with pen and pencil fittings and lengthening bar, a 5-inch hair divided, three spring bows, two drawing pens, a pricker, keys, spare leads, and needles The instruments are of the best English design and finish, with knee joints and nut and bolt needle points where necessary

A student who possesses this case of instruments is so far well equipped for his work in drawing and graphics, and gets exceedingly good value The instruments can be highly recommended as being entirely suited to their purpose

A Second German Course for Science Students By Prof H G Fiedler and F F Sandbach Pp vii+76 (London A Moring, Ltd, 1906) Price 2s 6d net

IN a former volume, favourably noticed in NATURE of May 24, 1906 (vol lxxiv, p 78), the authors described a series of simple lessons in science suitable for reading by elementary students of the German language The present volume contains extracts from recent German scientific publications—books, periodicals and proceedings of societies—of a more technical character but arranged, so far as possible, in order of difficulty Some notes on unusual words and phrases, hints on the use of a dictionary, a grammatical summary, and a list of abbreviations provide all the assistance the reader is likely to require at this stage The extracts have been carefully selected, and will be read with interest and profit by students of physics and chemistry who have a slight knowledge of German

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

One Vote, One Value

A CERTAIN class of problems do not as yet appear to be solved according to scientific rules, though they are of much importance and of frequent recurrence. Two examples will suffice. (1) A jury has to assess damages. (2) The council of a society has to fix on a sum of money, suitable for some particular purpose. Each voter, whether of the jury or of the council, has equal authority with each of his colleagues. How can the right conclusion be reached, considering that there may be as many different estimates as there are members? That conclusion is clearly *not* the *average* of all the estimates, which would give a voting power to "cranks" in proportion to their crankiness. One absurdly large or small estimate would leave a greater impress on the result than one of reasonable amount, and the more an estimate diverges from the bulk of the rest, the more influence would it exert. I wish to point out that the estimate to which least objection can be raised is the *middlemost* estimate, the number of votes that it is too high being exactly balanced by the number of votes that it is too low. Every other estimate is condemned by a majority of voters as being either too high or too low, the middlemost alone escaping this condemnation. The number of voters may be odd or even. If odd, there is one middlemost value; thus in 11 votes the middlemost is the 6th, in 99 votes the middlemost is the 50th. If the number of voters be even there are two middlemost values, the mean of which must be taken; thus in 12 votes the middlemost lies between the 6th and the 7th, in 100 votes between the 50th and the 51st. Generally, in $2n-1$ votes the middlemost is the nth, in $2n$ votes it lies between the nth and the $(n+1)$th.

I suggest that the process for a jury on their retirement should be (1) to discuss and interchange views; (2) for each juryman to write his own independent estimate on a separate slip of paper; (3) for the foreman to arrange the slips in the order of the values written on them; (4) to take the average of the 6th and 7th as the verdict, which might be finally approved as a substantive proposition. Similarly as regards the resolutions of councils, having regard to the above ($2n-1$) and $2n$ remarks.

FRANCIS GALTON.

A New Volcanic Island

THE officer in charge of the Marine Survey of India, Commander W. G. Beauchamp, R.I.M., has forwarded the following description of Volcano Island derived from an examination made about sixteen days after its appearance above water. The island is situated off the coast of Arakan, in the Bay of Bengal, about nine miles to the north-westward of Cheduba Island, and has a greatest length of 307 yards in a S.S.W. and N.N.E. direction, and a greatest breadth of 217 yards in a N.W. and S.E. direction; the summit is 19 feet above high water.

Except close to the shore the soundings in the neighbourhood appear to be unaltered, including the shoal to the N.N.W., which was touched on one line of soundings. The ship approached the island from the north-eastward, and left in an E.S.E. direction. A steam cutter left to the southward for ten miles and returned from S.S.E., and on neither course was any discrepancy in the chart discovered.

The island is still in an active condition at the northern end, several hot springs of liquid mud overflowing. It is steeper on the western side.

Temperatures (Fahrenheit) were taken at different parts of the island, the surface registering 81°, being the same as the atmosphere, at 2 feet below the surface 96°, 3 feet below surface 104°. But at the observation spot on the summit, and evidently the main crater, the temperature at 1 foot below the surface was 104°, at 2 feet below 108°, at 3 feet below 138°, and at 3½ feet the thermometer rose to 148°. No self-registering thermometer was available to take the temperature of the liquid mud. The ordinary thermometer could not be cleaned quickly enough to get an accurate reading.

The island is evidently becoming hard, but the action of the sea and tide is washing it away considerably at present, leaving a wake of discoloured water, giving the appearance of a shoal spit. The Admiralty charts show that several mud volcanoes exist in the neighbourhood.

Drift-wood, sand, and stones were found, although the island was only fifteen or sixteen days old. Fourteen kinds of seed were collected by the surgeon naturalist, from whose geological report it appears that the island is composed wholly of greyish-brown mud of uniform quality throughout; with this are a few angular fragments of rocks of various kinds intermingled. These must have been thrown up with the mud; they include:—(*a*) portions of a laminated sandstone; (*b*) a compact grey rock which has the appearance of a limestone, but which is only partially soluble in strong acids; (*c*) lumps of crystalline calcite; (*d*) a soft green stone, probably a basic igneous rock.

On December 31, 1906, the surface was sun-dried and hardened, so as readily to support the weight of a man. The dried surface is very uneven throughout; it has a nodular and bubbly appearance; besides this, it is split up by deep fissures, due to shrinkage in drying.

On the north side of the island are several small vents. Three of these open into round pools of liquid mud, to the surface of which large bubbles of gas are continually rising. This gas is non-inflammable, and does not support combustion; it has an objectionable sulphurous smell.

In regard to the permanence of this island, considering the nature of the material of which it is composed, it is likely that heavy rains and sea action in the south-west monsoon will cause rapid disintegration and total disappearance, always provided that no more material is erupted.

The following case may be quoted from Lyell's "Principles of Geology," vol. ii.:—In 1811 the Isle of Sabrina was formed off the Azores by submarine volcanic action. This, although 300 feet high, "was soon washed away by the waves."

A. MOSTYN FIELD.

Hydrographic Department, Admiralty, London, S.W.

The Forest-pig of Central Africa

As will be remembered, the singular and interesting forest-pig *Hylochoerus meinertzhageni*, which appears to be an intermediate link between the true Sus and the aberrant Phacochœrus, was first mentioned and named by my friend Mr. Oldfield Thomas in these pages (NATURE, vol. lxx., p. 577, 1904). I believe, therefore, that some further information which widens considerably its range may prove of interest to readers of NATURE.

The type of this remarkable pig is the cranium of a nearly adult male from the Nandi country (F.N.E. of the Victoria Nyanza), sent home by Lieut. R. Meinertzhagen, and now in the British Museum; this, with parts of the skulls of an older male specimen and of a sow, with portions of the skin covered with long black hair of the first, are the materials on which Mr. O. Thomas has described this species (Proc. Zool. Soc. London, 1904, ii., p. 193, pl. xiv., xv.). Since then further materials have been received by the British Museum, also the skull of what appears to be a second species (Proc. Zool. Soc. London, 1906, p. 2).

The Royal Zoological Museum of Florence received a few months ago from Lieut. Ernesto Brissoni, an officer in the service of the Congo Free State, a perfect cranium of a large full-grown male of *H. meinertzhageni*, shot by him at Sendue, on the Upper Congo River, where he was stationed for many months in November, 1904. It is a remarkably big and massive skull, as will be seen by the principal measurements, which, to facilitate comparison, I give in the same order as those taken on the type-specimen by Mr. Thomas; they are in millimetres:—greatest median length, above 425; basal length, 360; zygomatic breadth, 250; nasals, length 260, breadth 70; interorbital breadth, 123; tip to tip of post-orbital processes, 155; intertemporal breadth, 98; breadth across

lateral occipital protuberances, 140, height from basion to top of occipital crest, 137, least breadth maxillary zygomatic process, 70, breadth across sockets of canines, 70, breadth across tips of canines, 290, length of palate, 270, least palatal breadth, between m^2, 40, basal diameter of canine, 40, lower jaw, length, bone only, 325, breadth across symphysis at base of canines, 130, least breadth across diastema, 105, height at diastema, 55, tip to tip of canines, 225 basal diameter, outer face of canines, 22, inner face, 24, posterior face, 16, horizontal length of p^4, 15, of m^1, 19, of m^2, 26·5, of m^3, 45

Dental formula $i\,\frac{3}{3}\,c\,\frac{1}{1}\,p\,\frac{4}{4}\,m\,\frac{2}{3}$

As I have said, this cranium is massive, the bones rugose on their outer surface, the nasals mostly fused together, and the frontal depression strongly marked

HENRY H GIGLIOLI

Florence, Royal Zoological Museum, February 17

Gambling and Mathematics

YOUR reviewer "G H B" suggested in NATURE of January 31 (p 318) that every schoolboy should know something about choice and chance in order that he may not develop into a gambler I agree with him But one may suspect that gamblers are either those who have not had the advantages of a mathematical education or those who belong to 'slow dull' grade and are unable to appreciate those advantages, and yet one may be quite unable to prove that this is really the case

Can any of your correspondents bring forward evidence to show that mathematicians gamble less than other men, or that gamblers really are mathematically defective?

The matter is important as indicating the point at which the efforts of an anti-gambling league should be most usefully applied Is it in the intelligent teaching of mathematics? And are we right in distrusting the methods of exhortation when the methods of algebra will suffice?

Bootham School, York HUGH RICHARDSON

THE subject of Mr Richardson's letter raises a wide field of discussion, of which the few words in my notice convey a very imperfect idea I should like to see the matter discussed in a suitable quarter when such can be found, but I believe it is a question for psychologists as well as mathematicians

I take it that the ordinary gambler speculates in order to *win*, and that the prospect of *winning* is the incentive which does the greatest harm

When a man speculates by staking, say, 1*l* on the chance of winning 100*l*, the notion of winning 100*l* makes a big impression on his mind, and means something more real to him than the idea that the odds are 200 to 1 against him (say) He forms a clear mental picture of the prize, and the odds do not present the same picture to his mind Consequently he exaggerates his prospects What I meant to imply is that schoolboys ought to learn to calculate probabilities so that when they grow up they should think as clearly and form as strong mental pictures of the odds against them in a game of chance as they do of the value of the prizes, and that they should learn to calculate expectations and to think of these rather than of the prizes

But when Mr Richardson uses the word "algebra" he implies something different from what I mean, which is more correctly described as arithmetic What I should like would be to see a chapter on probabilities treated in an elementary course of arithmetic, and boys familiarised with the idea of probability calculations, the representation of probabilities by fractions, and the calculation of expectations, without any algebra being put in to puzzle them Quite simple questions, in fact I will not say that everyone who had studied probabilities would not indulge in a game of chance now and then but they would go in with the expectation of losing rather than winning, and they would know it was no use to try to make up a loss by making false estimates of the probability of the luck turning If nobody gambled except for the amusement and if everybody before doing so made a calculation beforehand as to how much they were prepared to pay for that amusement, realising that their expectation in every case was a loss (if playing against a bank), the worst evil of gambling would be eliminated The only difficulty would be the psychological one of preventing a man from being carried away by his excitement

What people should know is that to speculate against a bank or syndicate is a bad investment, and that even to speculate where all profits are distributed between players is not a paying investment, but is really also a bad investment even if the expectation equals the man's stake, on the ground that a bird in the hand is worth two in the bush The loss of the bird in the hand means a definite loss of income, the expectation cannot be regarded as income G H B

Some New Methods in Meteorology

SINCE the appearance in NATURE of December 20, 1906, of my review of Prof Bigelow's "Studies" under the above title, I have had some correspondence with Prof Willis L Moore chief of the U S Weather Bureau I am glad, with Prof Willis Moore's sanction, to quote part of his letters to me, which will, I hope, allay any apprehensions which may have been aroused as to the methods of research likely to be adopted at the new Mount Weather Observatory Prof Moore writes —" Since June, 1905, Prof William J Humphreys of Johns Hopkins University, and formerly Professor of Physics at the University of Virginia, has been Supervising Director at our institution at Mt Weather We wish to ascertain facts by experimentation, rather than to exploit theories, however beautiful they may be We consider Prof Bigelow's numerous papers as expressing simply his own views Neither myself nor any member of my staff desires to be considered responsible for any theories that may be advanced in the publications of the Bureau, except he be the author "

Prof Willis Moore's explanation, and his recognition of *experiment as the necessary and ultimate criterion*, justify the expectation that, backed as it is by the resources of the U S Weather Bureau, the new research observatory at Mount Weather will prove a most useful institution for the advancement of scientific meteorology

CHARLES CHREE

PAGAN RACES OF THE MALAY PENINSULA [1]

THE scope of this work, which runs to nearly 1600 pages is defined in the preface, where it is stated to be "essentially a compilation from many sources," but differing from most books of that kind, "first, in being based to a very large extent on materials hitherto unpublished, and accessible only through private channels of information, and secondly in having been constructed with special knowledge of the subject and in a critical spirit"

Accurate though these statements be, they offer but slight indication of how thoroughly the book is inspired with the experience and critical knowledge of the authors, and how well the subjects dealt with have been unified in their hands, a task the difficulty of which may be judged in part by a consideration of the unsatisfactory nature of much that has been written as well as by the length of the bibliography which follows the preface The authors explain that the several parts of the book dealing with the physical and cultural characteristics of the tribes had been originally arranged under subject headings, and that the book was then re-written upon "a phylogenetic system, so as to throw into relief the differences which separate one race from another," a plan which no one will doubt has added immensely to the clarity of the work Although the title-page bears the name of both authors, the greater part of the work has been written by Mr Skeat, Mr Blagden

1 "Pagan Races of the Malay Peninsula By W W Skeat and C O Blagden Vol I, pp xl+724, vol II pp xi+855 (London Macmillan and Co., Ltd, 1906.) Price 42s net

being responsible only for the section dealing with language, although each author has "as far as possible revised and checked the work of the other."

An introduction in which Mr. Skeat sketches with great skill and literary force the environment of the jungle-dwelling folk shows how this has produced characteristic forms of culture, and has compelled the jungle tribes to become perhaps the finest hunters and trappers in Asia. This is succeeded by the first section of the work, that on racial characters, and here, at the very beginning of the work, the reader is faced by its gravest defect; in the whole of the first volume there is no map of the Peninsula, the necessity for which soon becomes manifest and is most urgently felt, *e.g.* on p. 55, where the distribution of the Sakai is given. Indeed, the only map of the Peninsula appears at the end of vol. ii., where it forms part of a small-scale map of Indo-China (about two degrees to the inch), which includes the Andamans, Sumatra, Cambodia, and part of Siam. But to return to the discussion of racial affinities, Mr. Skeat will have nothing to do with the pan-negrito beliefs of some of the earlier writers, but leaves it doubtful whether he follows Virchow in regarding the Sakai as Dravidian or as related to certain of the wild tribes of the interior of Cambodia with whose language the Sakai dialects have an admitted affinity. The Jakun are regarded as a composite group of principally aboriginal-Malay tribes, many of which have intermarried freely with Semang and Sakai. It is only necessary to look through the numerous illustrations of individuals or groups, posed so as to show their physical characteristics, contained in these volumes to see how freely the jungle races have in certain instances mixed with each other, and the results of such intermarriage are shown, *e.g.*, in a photograph of a Sakai family the individual members of which, to mention only one physical character, have wavy, curly, and tightly coiled, almost frizzly hair. A number of valuable data bearing upon questions of race are given in tabular form in an appendix; some of these are by Dr. W. L. H. Duckworth, who also contributes a note in the text upon the craniological collection made by Messrs. Annandale and Robinson.

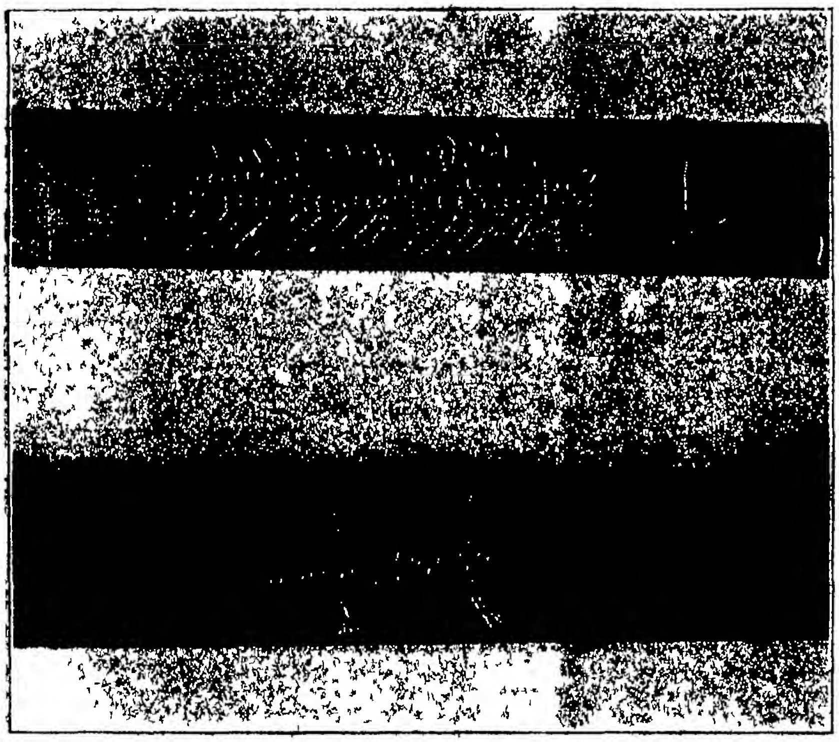


FIG. 1.—Besisi Zoomorphs. Centipede on Besisi flute; Lizard on shaft of Besisi blowpipe. From "Pagan Races of the Malay Peninsula."

A short *précis* of the distinguishing cultural peculiarities of the jungle people most usefully follows the description of their physical peculiarities. The Semang are the most nomadic, the wilder tribes "never staying it is alleged more than three days in one place", their habitations consist of natural shelters under overhanging rocks or of the simplest form of leaf shelters. Their national weapon is the bow with poisoned arrows, though the blow-pipe has been to some extent adopted; they are monogamous, and feel no such fear of the ghosts of their dead as do the Sakai and Jakun. The Sakai, though largely nomadic, are less wild than the Semang, and, unlike the latter, tattoo the face, while body painting has been developed into a regular system. Their weapon is the blow-pipe, with poisoned darts. The Jakun are only partially nomadic, and usually cultivate rice, sugar, or other plants, especially durian trees; they make and use dug-out canoes and the blow-pipe. They have chiefs, who in some cases have regalia, their marriage and burial rites are peculiar, and they have many magic ceremonies and invocations, in other words, their culture is "proto-Malay."

The habitations of these jungle tribes, which are discussed in chapter iii., are particularly intersting. Starting with shallow rock shelters and the buttresses of trees, the series passes through the "primitive bee-hive" or round hut composed of a number of palm leaves thrust into the ground in a circle, and is continued through the communal shelter (which is originally only an oval "beehive") until a break occurs, and a hut, originally probably a small granary or storehouse on one or more high posts, is reached, which, as the height and stoutness of the posts become reduced, tends to conform with the common Malayan hut type. In this series no mention has been made of tree houses, though Semang and Sakai alike make use of these, which may vary from a few roughly interwoven boughs to veritable houses in trees.

The houses of the less wild Jakun resemble in a general way those of the Malays, but are much smaller than the latter, while the eaves are often carried down to the level of the floor. It is among these people that tribal halls, called balai by both Malay and Jakun, first appear, and Mr. Skeat describes how some Besisi met with on the Selangor coast built a balai at right angles to, and in continuity with, the house of their tribal chief (Batin). Such

Sakai are mentioned in Besisi songs, and Mr Skeat holds that their existence is not due to borrowing from the Malays, but is "rather an example of a custom sprung from their common origin."

Closely associated with the character of their dwellings is the form of agriculture of these backward people. A Malay chief of Selangor informed Mr Skeat that the Besisi were originally in the habit of eating their jungle fruits in temporary shelters built where the fruit trees were most abundant, but that later, recognising that this practice resulted in overcrowding of the fruit trees which sprang from their rejected seeds, these folk took to carrying their fruit to a little distance before eating it, so as to spread the seeds over as wide an area of country as possible It must be remembered that all these aborigines are adepts at tree-felling, and there seems no doubt that fruit seeds or seedlings of fruit-bearing plants may be planted by the wilder tribes, who do not eat rice or any grain, except when they obtain a small supply by barter Those Semang who have reached an early stage of agriculture sow a species of millet Hill rice comes later, but while the folk are still semi-nomadic, and to it is added small catch-crops such as bananas, tapioca, and sweet potatoes, and among the Sakai who have reached this stage of agriculture the preparation of the ground and the sowing and harvesting of the crops are alike accompanied by magic ceremonies and formulæ

A full description of the weapons and implements at present used provides Mr Skeat with the opportunity of discussing the origin of the stone adze blades found all over the Malay Peninsula Unlike the up-country folk of Borneo, who highly value these and hang them in the verandahs of their houses among the skulls they have collected, the Semang and Sakai pay no attention to them, and it seems that these tribes "were not the manufacturers of the stone axes and chisels found in the Peninsula," which may perhaps be attributed to a race described by the jungle folk as once inhabiting their country, though different from themselves and the Malays

Among all the jungle tribes of the peninsula, the marriage rite consists largely of a form of purchase, usually followed by the ritual sharing and eating of food by bride and bridegroom, but among some Jakun tribes a part of the marriage ceremony consists of a procession or race by the bride and bridegroom around a specially erected mound, while among the Benua of Johor a canoe race, in which the bride is given a considerable start, is substituted

No less than a hundred pages are devoted to the subject of decorative art, *i e* to the art of the Semang and Sakai, described by Mr Skeat as "by far the most difficult of the many difficult subjects that have had to be faced in compiling the description of these tribes," for it is necessary "to face the fact that with reference to part of this subject an edifice has already been reared upon a foundation of sand, and that though the bricks of which it was composed may to some extent be useful in laying the foundation of the new building, the original edifice is none the less inevitably doomed to irremediable destruction." This, of course, refers to Vaughan-Stevens's flower theory, and in spite of the no less generous than skilful editing and pruning to which the latter's work has been subjected, it is impossible to believe that Mr. Skeat would not have done better to have omitted by far the greater part of his account of Vaughan-Stevens's work, and this notwithstanding the writer's very hearty recognition that no one is so fit as Mr Skeat to determine the value of Vaughan-Stevens's observations The feeling that Mr. Skeat's modesty and desire to give the fullest credit to other workers have for once run away with much of his critical faculty becomes stronger as the chapter is studied, and ends in the quite deliberate conviction that it was a mistake to reproduce pages of the patterns on combs copied from the *Zeitschrift für Ethnologie*, while the decorated dart quivers, combs, and boxes collected by Mr Skeat himself are reproduced on so small a scale that it is impossible in most instances to see the designs at all clearly. Further, although the meaning of some of these is given on p 419, it is by no means clear to which objects these refer, or whether pp 416–8 are in fact descriptions, as they appear to be, of the quivers figured in the plate facing p 414 Very little indeed is known about Jakun art The two realistic zoomorphs shown in Fig 1, representing a centipede and a lizard, occur on a Besisi flute and blow-pipe respectively, while two highly conventionalised patterns, said to be derived from the young shoot of plants, are also given

The difficulty of obtaining information concerning the religious beliefs of these jungle-dwelling tribes was very great, it was only after many conversations with both eastern and western Semang concerning the existence of any supreme being, of whom they long professed entire ignorance, that one of them exclaimed, "Now we will really tell you all we know," and proceeded to tell Mr Skeat about Ta Ponn, a powerful and benevolent, if otiose, deity, who made the world and who was "like a Malay Raja" in that "there was nobody above him" Although Ta Ponn is obviously identical with Vaughan-Stevens's "Tappern," nothing could be discovered concerning Vaughan-Stevens's superior deities of the Semang called by him Kari and Ple, although Mr. Skeat witnessed a "blood-throwing" ceremony among the eastern Semang resembling that by which, according to Vaughan-Stevens, Ple was appeased. As already stated, the Semang have little fear of ghosts, and their religion shows comparatively few traces of demon-worship and animism The Sakai beliefs, on the other hand, although admitting a "god" Tuhan (or Peng), who in company with the giantess "Granny Long-breasts" inhabits the upper heavens, are almost entirely animistic, as are those of the Jakun, and for both peoples there are numerous demons to be propitiated

It is particularly interesting to note that the two savage races of the peninsula that stand furthest apart, namely, the Semang and the Jakun, both have the idea that man at first multiplied so fast as to overcrowd the earth When this occurred they were slain by the fiery breath of the Thunder Spirit (Semang) or turned into trees by the "high" god Tuhan Di-bawah (Jakun) but in both stories these checks do not suffice, and so death is instituted, and Mr Skeat again suggests that such common features are mainly due to the "same savage Malay element of which there are such abundant traces in the dialects of both races"

As among Malays, so among these jungle tribes, the accredited intermediary between men and spirits is the medicine man or sorcerer Among the Semang he is usually the chief, that is to say, the poyang is, by virtue of his office, chief Among Sakai and Jakun the offices are sometimes separated, though the chief is usually a medicine man of some repute

In the last part of the work, devoted to the language of the jungle folk, Mr Blagden points out that most aboriginal dialects have been for some generations in a process of decay, and that Malay is so widely known as to have become the *lingua franca* of the peninsula, so that many of the aboriginals are now bilingual, while others speak

only Malay, more or less modified according to the national idiosyncrasies of the speaker. Moreover, many of the Malayan loan-words are pronounced, not as the Malays of the peninsula pronounce them to-day, but as it would seem they were pronounced when Malay was first written in Arabic characters, thus, the *k* still pronounced in Borneo also occurs in the aboriginal dialects. Besides unidentified elements, many constituents of both Semang and Sakai dialects agree with the Mon-Khmer languages, but whether this similarity be due to all these languages being essentially members of one family or to the direct contact of Semang and Sakai with Mon-Khmer peoples is uncertain, though, of course the two views do not necessarily exclude each other. There is a most interesting chapter on tabu language and other special forms of speech, and the work concludes with a comparative vocabulary of the aboriginal dialects, which is so arranged as to be particularly easy to use. C. G. S.

ELECTRIC POWER IN LONDON

UNTIL a couple of years ago the problem of electricity supply in London was mainly one of interest to engineers and investors. Its introduction into the realm of municipal politics, however, has given it a wider interest, and one that tends to obscure the purely scientific aspect of the problem. Alike in connection with water, with gas, and with electricity, London has suffered from the fact of its slow growth and of its being composed of a number of separate towns and districts, its very magnitude, which to-day would enable it to be supplied with electricity more cheaply than any other great city, has been the chief hindrance to its getting such a supply. The enormous number of authorities authorised to supply electricity in Greater London, which at the present time exceeds seventy, has resulted in the establishment of nearly sixty generating stations, many of which are of comparatively small size and inefficient design. The municipal authorities have also been confined to their own boundaries and compelled to choose uneconomical sites, and any attempts at combination between the various authorities which might have enabled them to secure some of the advantages of production on a larger scale have been prevented by the restrictive legislation under which they operate, legislation which was originally passed before the future developments of electricity production were appreciated, while the still more remarkable developments in the uses of electric power were entirely unforeseen. An attempt at concentration was long ago made by the London Electric Supply Corporation, which established its great station at Deptford. That it was not successful was not due to any unsoundness of the principle upon which it was based, but to the fact that it was before its time. Fifteen years afterwards, in 1905, a fresh proposal embodying the first step in the policy of concentration was brought forward by a private company, several of the existing companies at the same time brought forward proposals, not for complete concentration, but for dividing London into three areas, in each of which a supply would be ultimately centralised.

The former scheme, due to its novelty and comprehensive nature, aroused considerable controversy. It was framed on the lines of the various Power Acts which Parliament has passed during the past five years. That is to say, it did not deal with retail supply of *lighting*, but only authorised wholesale supply of electricity and the retail supply of *power* in cases where the Board of Trade thought such supply should be given. Its main object was the establishment of two stations, in which generation would take place on a scale much larger than that of any station in London to-day, and from which electricity would be supplied wholesale to the various distributing authorities by whom it would be retailed to the consumer. The limited right to supply the power consumer direct, in certain cases, was inserted by Parliament in order to ensure that the distributor should not absorb all the advantages of wholesale production.

This scheme naturally aroused much opposition from the existing authorities, both municipal and company. To a large extent, however, this disappeared as the real nature of the Bill became known, in fact, practically all the leading companies, and many of the most business-like local authorities, appreciating the advantages of purchasing a bulk supply in place of having constantly to expend further capital on extending their own smaller generating stations, entered into agreements with the promoters. The manufacturing interests of London also supported the scheme very warmly, and a deputation of leading manufacturers waited upon the Board of Trade, and showed that if the East End could obtain power at the prices fixed by the Bill it would mean an annual saving of nearly 3,000,000*l* as compared with the present methods of power production. A petition, signed by employers of 100,000 hands, was also presented to Parliament in favour of the scheme.

It was, however, strongly opposed by the London County Council, which, in spite of numerous modifications and safeguards, such as the sliding scale of price and dividend, and the purchase clause, which were inserted in the Bill by Parliament, contended that it was not in the public interest that such a scheme should become law. It, however, passed Committees of both Houses, but so late in the session that it failed to become law.

In the next session of Parliament, 1906, the County Council itself introduced a scheme. The 1905 company's Bill was also re-introduced, and a new scheme was brought forward by the existing companies for linking up their systems and removing the restrictions upon mutual supply to which reference has already been made. The County Council's scheme alone received a second reading, and was sent to a special Hybrid Committee with instructions to consider the whole question.

The County Council's scheme dealt with wholesale supply only, it was strongly criticised by the Council's own Finance Committee, and unanimously rejected by the House of Commons Committee which had been instructed specially to consider it. The Report of that Committee recommended, however, that the Council should be made the controlling authority for electricity supply, but as regards the carrying out of the undertaking suggested that the Council should consider cooperation with private enterprise.

This year the Council has brought forward a more comprehensive scheme, involving nothing less than a monopoly of electricity supply for all purposes over 450 square miles, 330 of which are outside the county. Fourteen of the borough council undertakings are to be compulsorily acquired within five years, the thirteen company undertakings as their concessions lapse. Undertakings outside the county of London are to be acquired by agreement, but until it has secured this monopoly, and to assist in securing it, the Council takes powers to compete (for power supply only) with all these undertakings.

From a scientific point of view the principle of concentration would appear to be correct, but whether electricity supply has reached a state of development when such a big step forward as that proposed by

the Council would be wise is somewhat doubtful There is no engineering impossibility in wiping out all the existing generating stations with their various systems of supply and in producing the whole of the electricity required for London in a station erected at Barking or Erith, as the Council proposes But from the financial point of view the magnitude of the scheme appears to be its chief difficulty Seventeen millions have already been sunk in electricity supply in London, and, according to a careful estimate in a leading financial journal, this sum would have to be nearly doubled before the Council could secure the monopoly at which it aims Before embarking upon such a scheme, from which when once started there is no turning back, the ratepayers need to be very sure of the future developments of electricity Three times in the past twenty years have the prime movers used for electrical production been entirely changed The slow-speed horizontal engines which had been developed during the nineteenth century were first used, and gave place during the 'eighties to high-speed engines of the single-acting or forced-lubricating type for electrical supply These are now being replaced by steam turbines Many inventors are, however at work upon the improvement of large gas engines and other internal-combustion machines, and the attempts which have been made to construct a satisfactory internal-combustion turbine may any day bear fruit

Now it is obvious that if electricity production in London should become municipalised, so far as London is concerned the rate of development and the adoption of improved methods will be much hindered Experience has shown that local authorities are, as in fact they should be, very cautious in adopting scientific improvements This partly arises from a proper regard for the ratepayers' money, but partly from their objection to acknowledge that they have made a mistake and to the consequent criticism of the electorate

This being so, it would be most unfortunate if anything should be done that would hinder the progress of electrical developments in the metropolis London is so large that it could certainly afford to get the best in the first instance, the difficulty is to ensure a continuance in the adoption of the most efficient methods when concerns are municipalised To day the generating station erected by the Council at Greenwich is practically obsolete as an up-to-date power house

The problem is one, however, crying for solution The need for some improvement in London electrical supply is generally admitted, as are the advantages arising from concentration The best solution of the difficulty is probably that outlined in the report of the Council's Finance Committee issued in December, which closed with the following words —

"The financial difficulties to which we have called the attention of the Council would to a large extent be obviated if the Council saw its way to adopt some scheme of exercising the powers sought, if and when conferred by Parliament, by which the Council, while retaining general control, would be relieved of the responsibility of working the undertaking in whole or in part"

Whether the solution will be brought about by enlarging the existing stations as their owners propose, or by erecting new and larger stations on more convenient sites outside, as other experts desire, is a question which must be settled by a Parliamentary Committee and the Board of Trade But more delay in concentration will be fatal to London's industrial future, and is quite unnecessary if only the Council will realise the need for cooperating with private enterprise, as the Select Committee suggested

PROF HENRI MOISSAN [1]

It was with deep sorrow that the scientific world learnt of the death of the illustrious French chemist Henri Moissan, which occurred on Wednesday, February 20, following an operation for appendicitis

Born in Paris on September 28, 1852, Moissan early developed an interest in chemistry, and in 1872 entered the laboratory of Fremy at the Muséum d'Histoire naturelle, attending also the courses of Henri Sainte-Claire Deville, Debray, and others

This early training firmly fixed the direction of his life's work, for it is precisely along the lines so ably developed by this brilliant school of French chemists that Moissan's genius and resource in experimentation were applied Worthily to have upheld the traditions and high quality of this school and to have widened the field of inorganic chemistry required powers of no mean order

From 1873 to 1879 Moissan held the post of assistant in the laboratory of MM Decaisne and Dehérain at the Muséum d'Histoire naturelle, and in 1874 published, in conjunction with M Dehérain, his first contribution to science, a study of the absorption of oxygen and emission of carbonic acid by plants kept in a darkened room In 1877 a series of papers on the oxides of the metals of the iron group was commenced the whole work being collected and presented in 1880 as a thesis for the degree of *Docteur ès sciences* of the Faculty of Sciences of the Paris University This research, carried out with much experimental skill and precision, considerably extended our knowledge of the reduction products of the oxides of iron, manganese, nickel, and chromium

A long connection with the École supérieure de Pharmacie commenced in 1879, by his appointment as demonstrator in chemistry; the chair of toxicology being given him in 1887, after his memorable isolation of fluorine, and finally the professorship of *chimie minérale* in 1899, when his first opportunity occurred for holding a course of lectures on chemistry

After his graduation, Moissan, from 1879 to 1883 devoted himself chiefly to the study of the compounds of chromium, investigating in particular the chromous salts and perchromic acid Subsequently, in the laboratory of Debray, and with the active encouragement of Troost and Friedel, he commenced his researches upon fluorine which culminated in 1886 in the isolation of this element

The difficulties, which had baffled the experimental ability of Humphry Davy, Faraday, Fremy, and many others, were overcome and fluorine itself was presented to us That this may justly be considered to be one of the greatest achievements of experimental chemistry in the nineteenth century can be judged not so much by the brilliant result attained as by the display of indomitable pluck and perseverance which assured the successful issue

After a number of fruitless but well-planned attempts to separate the element from its compounds with silicon, phosphorus and arsenic, Moissan, on June 28, 1886, communicated to the Academy of Sciences the first details of his experiments on the electrolysis of anhydrous hydrofluoric acid containing potassium bifluoride The definite proofs of the identity and elementary nature of fluorine were presented in the following month, whilst, on November 8, Debray reported to the Academy the complete conviction of the section of chemistry in the validity of the experiments

From 1886 to 1891 Moissan published numerous

[1] See also the article on Moissan's laboratory and his work in it in NATURE, January 16, 1902, vol lxv p 252

papers on the chemical and physical properties of fluorine and on many of its compounds, the careful and detailed nature of the investigations being characteristic of all his work

It is unnecessary to describe further these researches, since the whole subject forms a chapter of their science well known to all chemists, and has, moreover, already been fully dealt with in NATURE (vol xxxvii, p 179, vol xliv, p 622) Attention should, however, be directed to the fact that in 1897, in conjunction with Sir James Dewar, fluorine was liquefied at the Royal Institution The construction of an apparatus of copper in 1899, to replace the expensive platinum vessels previously employed, simplified the preparation of the element, and the discovery that dry fluorine exempt from vapours of hydrofluoric acid does not attack glass served in recent years to facilitate the investigation of its properties

In 1891 Moissan was elected a member of the Academy of Sciences to fill the chair left vacant by the death of Cahours

The main reason which impelled Moissan to pass from the study of fluorine to the high-temperature researches, which from 1892 onwards absorbed so much of his attention, seems to be closely connected with a desire, which he had long entertained, to solve the mystery of the origin of the diamond The hope that the great activity of fluorine for other elements would help in the quest not being realised, he was led to a methodical study of the behaviour and transformation of the three allotropic modifications of carbon This study, which is an excellent example of the logical application of experiment, resulted in the artificial production of diamond, and at the same time added greatly to our knowledge of the peculiar metamorphoses which characterise this element

The examination of portions of the meteorite from the Cañon Diablo proved the presence of small diamonds, surrounded by thin ribbon-like strips of compressed carbon, hidden in the centre of a mass of iron, and gave him the clue to the solution of the problem How he planned and successfully carried through the adaptation of this idea in the laboratory with the production of minute but unmistakable diamonds is well known to all Although this work has been frequently challenged, he had fully upheld the validity of the results, so recently as 1905, by repeating the experiments with still greater precautions, and by applying a more intimate knowledge of the compounds formed under similar conditions It was for the purpose of augmenting the solubility of carbon in iron that he first required and adopted the electric furnace

In electric furnace work, Moissan's preeminent position is due, not to the design or discovery of a special form of furnace, but rather to the skill with which he investigated in detail a number of individual chemical reactions In each case he devoted great care to the purification and analysis of the raw materials required in the process, and submitted the products to minute examination and quantitatively determined their composition Thus his preparation of chromium, tungsten, molybdenum, uranium, titanium, and many other metals in a fused form and high degree of purity greatly enriched our knowledge of the chemical and physical properties of these elements

Of still greater importance was the methodical following up of the chance formation of calcium carbide which he observed around the carbon electrodes in his early furnace experiments From this observation he was led to discover and determine fully the nature and properties of a large number of metallic carbides, borides, and silicides, most of them hitherto absolutely unknown, or, like the metals mentioned already, only obtainable as impure and fragmentary specimens

There is perhaps no need to consider, at the present time, in how far industry is directly indebted to Moissan's work He himself had invariably expressed his desire not to be considered in such discussions, and, so far as the merit of his work is concerned, it needs no support of this nature Indirectly, both science and industry have benefited enormously. On the Continent his scientific investigations are directly credited with a renaissance in the study of inorganic chemistry, which, particularly in Germany, had been almost entirely neglected for the more productive field of organic chemical research Even in England, which has always held a high position in the pursuit of inorganic chemistry, his work has been of great assistance in instilling enthusiasm and encouraging the deeper study of the subject

As a teacher, Moissan will be affectionately remembered by all his pupils; even during the tenure of his professorship of toxicology he maintained a research laboratory for chemistry, and attracted to it a number of students, and from the time of his appointment, in 1900, to the chair of inorganic chemistry at the Sorbonne larger numbers were able to avail themselves of his teaching

As a lecturer, both in his public discourses and in the lectures on inorganic chemistry, which he gave during the last few years of his life, he was distinguished, even amongst French chemists, by the brilliant exposition of his subject and by his skill in experimental demonstration R S HUTTON

NOTES

WE regret to see the announcement of the death of Mr H C Russell, C M G, F R S, Government astronomer of New South Wales

THE autumn meeting of the Iron and Steel Institute will be held in Vienna on September 23–25, and will be followed by excursions to Bohemia and to Styria

THE Women's Agricultural and Horticultural International Union is organising an exhibition and sale of farm and garden produce, &c, to be held in the Gardens of the Royal Botanic Society Regent's Park, N W, on Wednesday, July 17

THE Mercers' Company has made a grant of 1000*l* to the Imperial Institute for scientific research in regard to the economic products of British colonies and protectorates, to be expended under the direction of the managing committee, subject to the control of the Secretary of State for the Colonies

THE Friday evening discourse at the Royal Institution on March 8 will be delivered by Prof David James Hamilton, on "Certain Seasonal Diseases in the Sheep and means of preventing them"

ENGLISH geologists who know anything of France and the French Alps will especially regret the death of M Marcel Bertrand, which took place on February 13. His work on mountain-origins and mountain-structure had an important influence in the development of geological thought Bertrand succeeded Pasteur as a member of the French Academy of Sciences in 1896.

WE learn from the *Times* that the Royal Academy of Sciences at Stockholm is petitioning the Swedish Government to request the British Government to grant per-

mission for the removal of the remains of Emanuel Swedenborg from the Swedish Church, Princes Square, Ratcliff Highway, to Stockholm in order that they may be re-interred there by the side of the remains of the celebrated chemist, Berzelius

In the House of Commons on Tuesday, the Secretary of State for War was asked "whether he was aware that the Army Medical Department and the entire medical profession in this country were mainly dependent on foreign manufacturers for the supply of tubes for X-ray examinations" In reply Mr Haldane said —"The X-ray tubes required for military hospitals are purchased from contractors in this country who obtain many of their supplies from Continental manufacturers The few glass-blowers in this country who make X-ray tubes are unable at the present time to produce tubes in sufficient number to meet the demand or to equal in quality and price those manufactured abroad"

The Royal Academy of Sciences of Turin has announced the conditions under which the Vallauri prizes will be awarded One prize of 28,000 francs is offered to the Italian or foreign man of science who, between January 1, 1907, and December 31, 1910, publishes the most important work in the domain of the physical sciences, using the expression in the widest sense

Dr H M Birdwood whose death on February 21 has been received with regret, followed the example of his brother, Sir George Birdwood by using his botanical and horticultural interests for the public benefit while officially connected with India He was the author of a "Catalogue of the Flora of Matheran and Mahableshwar," two of the Bombay hill stations, and was a syndic of the Bombay University

An article in the *Times* of February 22 urges that the Explosives Research Committee is culpably responsible for the violent explosion at Woolwich a few weeks ago The explosion totally annihilated the magazine in which it occurred, wrecked a large number of houses in the vicinity, caused minor damages over a wide area, and produced a shock which was felt thirty miles away It is said that the research laboratory was improperly used for storing large quantities of dangerous compounds which ought not to have been near a place where experiments with explosives of unknown properties are carried on A letter signed "Scrutator" in the *Times* of February 12 states that the laboratory contained shells filled with condensed phosphuretted hydrogen and a gasometer full of this gas, and the article on February 22 asks, "what has become of the two kilograms of iodide of nitrogen the existence of which is common knowledge?" The suggestion that the explosion was due to recklessness and negligence in the research department at Woolwich is damaging to scientific interests, and it is to be hoped that the research board will afford the information required without delay

The council of the Society of Arts is prepared to award under the terms of the Benjamin Shaw trust, a gold medal, or a prize of 20*l*, "for any discovery, invention or newly-devised method for obviating or materially diminishing any risk to life, limb or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means" Intending competitors should send in descriptions of their inventions not later than December 31, 1907, to the secretary of the Society of Arts, Adelphi, London, W C

Another of the great teachers who have made Germany famous as a centre of geographical studies has passed away in the person of Dr Alfred Kirchhoff, who died at Leipzig on February 8 at the age of sixty-nine Only two years ago Kirchhoff was compelled by failing eyesight, amid universal regret, to resign the professorship of geography at Halle University, where his fruitful and stimulating labours extended over more than thirty years He wrote various educational works, and only last year supplied, in association with Dr S Günther a valuable treatise on geographical education to Baumeister's "Handbuch der Erziehungs- und Unterrichtslehre fur hohere Schulen" His bent lay naturally in the direction of regional geography, which gave full scope to the many-sided character of his knowledge, and perhaps one of his greatest services was as editor (among other important works) of the series entitled "Forschungen zur deutschen Landes- und Volkskunde," which has now reached its sixteenth volume Some of his studies on the relations between man and his environment attracted wide attention, and were published in a collected volume, which only last year was made available to English readers in Routledge's "Universal Library"

The Association of Italian Manufacturers has issued particulars of an international competition for prizes to be awarded for the prevention of accidents in factories Applications must be made before June 30 1908 to the association 61 Foro Bonaparte, Milan The nature and value of the prizes offered are as follow —(1) A gold medal and 8000 lire (320*l*) for a system to eliminate the danger of a contact (of whatever resistance) between the primary and secondary circuit of alternate-current transformers and their respective lines (2) A gold medal and 1000 lire for a hand-crane or winch so constructed that without sensibly reducing the efficiency or speed of lowering, as compared to ordinary types, any danger due to the rotation of the handles by the descending load is avoided Means must be provided to prevent the rotation of the handles during the descent of the load With each system competing for the prize in apparatus must be supplied which will enable it to be submitted to practical tests

English geologists lament the death, on February 15, of a well-known amateur Miss Caroline Birley Miss Birley was born in Manchester in 1851, and became interested in geological studies at an early age She travelled extensively in search of fossils and minerals and made a large collection, which was placed at the disposal of all to whom it could be of use for purposes of research Her more important fossils were Cretaceous Invertebrata from Faxe Denmark Pliocene shells from Bordighera and Pliocene shells in nodules from the Mekran coast, Baluchistan Her collection of minerals included some fine zeolites obtained from the Færöe Islands All the specimens desired by the British Museum are bequeathed to the nation, while the residue of the collection is given to the Manchester Museum Though herself a diligent and accomplished student, Miss Birley rarely published any notes of her work, but an interesting account of the Chalk section at Faxe from her pen prefaces Dr Henry Woodward's paper on Faxe fossils in the *Geological Magazine* for November, 1901 Miss Birley attended all the meetings of the British Association from 1887 onwards, and she was also an active member of the Geologists' Association The president of the Geological Society and the keeper of geology in the British Museum were present among a large circle of friends at her funeral, which took place at Lingfield, Surrey

A RECENT article distributed by the Decimal Association again directs attention to the advantages to a country of the introduction of the metric system of weights, measures, and coinage. Not the least of these advantages would be the saving of time to business men and workers of all kinds. To children at school the saving of time would be still greater, and this has been estimated with some exactness from figures provided by schoolmasters and others. The association states that the saving in educational time by the exclusive adoption of metric measures would be about 200 hours per child. If coinage also were decimalised, the saving would be increased to about 350 hours. That is, the association says, about 200 million hours a year for every of school-children's time could be saved by a reform which, it is estimated, would cost adults on the average about the equivalent of a day's work (adding the needed mental exertion to the cost of new weights, metre-sticks, and gauges). The Decimal Association asks for legislation to bring about the improvement advocated, but in the meantime good work is being done, and an increasing amount of attention is paid to teaching children at school the simplicity of the inter-relation of the various metric measures. It is interesting in this connection to notice that one of the earliest Parliamentary Bills on the list this session is Mr. B. S. Straus's Weights and Measures (Metric System) Bill, which is receiving strong support. The Bill proposes that from April 1, 1910, all the present British weights and measures shall be replaced by those of the metric system, and that Parliament shall order the Imperial standards to be altered and issued officially as metric standards. The Bill will make it compulsory that every contract or sale shall be by the new standard kilogram and metre. In order to introduce the new system easily, the Bill arranges that local authorities shall provide local standards at least a year before the Act comes into operation. The metric system is one of the subjects to be discussed at the Colonial Conference to be held in London in April.

AN obituary notice of Colonel Mannheim is contributed by Dr. J. Reveille to the *Revue générale des Sciences* for January 30, and may be read with interest side by side with a similar notice of Lieut.-General De Tilly in the Brussels *Bulletin de la Classe des Sciences*, 1906, p. 10, by M. P. Mansion. Colonel Mannheim, who was professor in the École Polytechnique, devoted his attention, in the first place, to theories of transformation in geometry, and his work is noticeable for the prominence given to metric as opposed to projective methods. Under the title of "kinematical geometry," he developed a large and interesting field of study in connection with the displacements of bodies possessing two degrees of freedom. In this case the trajectory of any point of the system consists, not of a straight line, but of a surface, and the properties of these surfaces were studied by Mannheim up to the third order of infinitesimals. They lead to properties analogous to those relating to focal lines in optics, an application which Mannheim was not tardy in using, and his work also contains interesting applications to the properties of deformable surfaces, theories of contact of the third order, and other problems in infinitesimal geometry. Lieut.-General De Tilly, who for some time was professor, and later director, of the Belgian Military College, was author of a large number of works on geometry and mechanics. At the age of twenty-three he published his "Recherches sur les Éléments de Géométrie," and eight years later he published an essay on the mechanics of non-Euclidean space. He too seems to have been attracted by metric rather than projective geometry, for in his "Essai de Géométrie analytique générale" of 1892, he showed that all geometry ultimately reduced to a single relation between $n+4$ points for space of n dimensions. He also wrote papers on ballistics, and was an authority on educational matters.

OWING to inquiries regarding the cultivation of ramie in Jamaica, information on the subject, extracted from several sources, was reprinted in the December (1906) number of the Bulletin of the Department of Agriculture. Mention is also made of a new decorticating machine, manufactured in Germany by Boeken and Co., of Duren, that is portable and low priced.

IN the first number of this year's volume of the *Kew Bulletin*, Mr. T. A. Sprague discusses the synonymy of the Chilian genus Tricuspidaria, defining two species, and Mr. C. H. Wright furnishes a *clavis* for the identification of the Chinese species of Eriocaulon. Mr. G. Massee contributes an account of the heteroecious uredine fungus, *Calyptospora Goeppertiana*, that grows on species of Vaccinium and transfers to fir trees, constituting a pest more particularly of the silver fir, *Abies pectinata*. A note on ramie respecting the experience of an association for producing the fibre in Tirhut, Bengal, is useful as indicating that there are considerable difficulties in the matter of doing so at a remunerative cost. A list of plants suitable for gardens in the warmer parts of the United Kingdom is supplied in the miscellaneous notes.

AMONG the summaries of recent research contained in *Science Progress*, not any are more useful than those which collate allied facts obtained by workers in different sciences. Prof. J. R. Green contributes an article of this nature on protein hydrolysis to the current number (January), in which he indicates how Cohnheim discovered in animals an enzyme, or more correctly a group of enzymes, that he called erepsin as distinguished from trypsin, while independently Vines had arrived at the conclusion that the so-called trypsin in plants is composed of two enzymes acting at different stages. As to the identity of the proteases in animals and plants, it can only be said that arguments tending in this direction may be adduced. Another botanical summary concerned with recent investigations on the fungi is written by Miss A. Lorrain-Smith, and a note on double fertilisation in plants is communicated by Miss E. N. Thomas.

THE growth in the North Andaman Island of the timber tree *Pterocarpus dalbergioides*, known as *padauk*, is the subject of an article in the *Indian Forester* (December 1906) by Mr. F. H. Todd. The vegetative formations of the island consist of a belt of mangrove or littoral evergreen forest, above which the *padauk* forest rises to an elevation of 300 feet, when dense evergreen forest takes its place. It is probable that a sheltered aspect is the chief factor regulating the limits of the *padauk* zone. With regard to the rich red colour that characterises the most valuable timber, as it has been observed in trees of large girth and in dead or dying trees, the author suggests that probably the colour deepens as the tree approaches maturity or decay. In the same number Sir Dietrich Brandis, referring to the identification of certain spruces growing in Sikkim, Chumbi, and Bhutan, remarks upon the anatomy of the leaves as a distinguishing feature, while leaving the determination to foresters on the spot.

PART I. of vol xxvii of the Transactions of the South African Philosophical Society is devoted to the description by Mr. R. Bergh, of Copenhagen, of a collection of South African opisthobranchiate molluscs Hitherto the known South African representatives of this group have been very few, but Mr Bergh has been able to describe quite a number of new species, many referable to the genus Aplysia Owing largely to the influence of currents, there is a marked difference between the marine faunas of the west and east sides of the Cape Peninsula, the latter having a more tropical Indian character Still however, typical forms of nudibranchs do occur on the west side The collection is due to the energy of Dr Gilchrist, after whom one of the species of Aplysia is named

WE have received copies of three papers dealing with injurious insects recently issued by the U S Department of Agriculture In the first of these, forming Farmers' Bulletin No 275, Mr L O Howard discusses the gipsy-moth (*Porthetria dispar*) and the means by which it can best be kept under control This moth we may remind our readers, is a European species accidentally introduced into Massachusetts some forty years ago, since which date it has spread to Rhode Island and parts of New Hampshire Connecticut, and Maine For a long time Massachusetts was left to fight the battle against the invader alone, but the Federal Government has at length recognised its duty of contributing to the expenses of the campaign Of the other two papers forming parts i and vi of Bulletin No 63 of the Bureau of Entomology one is devoted to the hibernation and development of the cotton-boll weevil and the other to its ally the strawberry weevil It has been stated that the best method of destroying the first-named species is by burning or grazing off the cotton stalks in early autumn, so as to reduce by starvation the numbers which hibernate As a large percentage die during hibernation this plan is obviously much more efficacious than are attempts at destruction in spring The strawberry weevil in 1905 inflicted damage on crops in Texas averaging about 12 5 per cent

OF all the statistical reports annually published in the volume on the mineral resources of the United States, issued by the U S Geological Survey, none is of greater interest than that dealing with the production of precious stones, and the report for 1905, an advance copy of which we have received from the author, Dr George F Kunz well maintains the high standard set by preceding reports It deals not only with the production of precious stones in the United States but also with the occurrence and production of precious stones in other parts of the world In the United States the year 1905 was a memorable one, as it marked a record for the importation of precious stones of every variety The value of diamonds and other precious stones amounted to little short of 7,000,000*l*., while the value of the production of precious stones in the United States was 65,250*l* The discovery of utahlite, a green variscite (aluminium phosphate), a translucent green stone used as a gem, at a new locality, forty miles south-west of Salt Lake City, promises to furnish a quantity of this peculiarly American stone that may be used in semi-barbaric jewellery In the mining of tourmaline, beryl, topaz, kunzite, and other stones peculiar to the southern counties of California some wonderful crystals of rose-coloured beryl implanted on felspar and many fine crystals of red and green tourmaline are found, and in connection with them occur many specimens of great mineralogical interest The region bids fair to excel that of the Ural, which for more than half a century has led the world in such products A novel departure has been the cutting of the chrysoprase found at Visalia, California, in its brown matrix, which forms a pleasing contrast to the green colour of the gem The emerald is still the stone most prized, and at no time has it received so high appreciation in price Within the last two years there has been immense improvement in lapidary work in the United States in every variety of stone There has been especial preference for many of the larger stones and never before have aquamarines, tourmalines, and amethysts been sold in such profusion

IN the *Bulletin de la Classe des Sciences* (Brussels) M P De Heen publishes a photograph, taken in the Place Saint Lambert during a thunderstorm, showing remarkable luminous effects emanating from each of the electric arc lamps at the instant of a flash of lightning These effects consist partly of bands of light passing from the lamps to the ground, which the author thinks may be caused by conduction currents, but in addition they include two luminous filaments emanating from each lamp, one forming a closed curve and the other curling round at its extremity in the form of a lasso M De Heen expresses the opinion that these effects have their seat in the ether and cannot be accounted for by any corpuscular (or electron) theory of electricity, but whatever may be said on this point, the discharges in question appear to be well worth careful study

IN the *British Journal of Photography* for February 15 there is an article entitled "British Plates in Germany" in which the writer refers to the great outcry against the increasing imports of English plates into Germany The reader will gather some idea of this great invasion of British-made plates from the following statistics (in kilos) which are given —

1903	1904	1905	1906
9600	23,300	38,700	83,000

The above figures show that, as the writer states, "in open markets the British dry plate has held its own against all comers, and has now shown its capability of disturbing the ranks of manufacturers in a country where home production is favoured and foreign competition handicapped by a tariff" The tremendous increase from the year 1905 to 1906 has been referred to in a German photographic journal as 'gefahrvoll fur die deutsche Industrie" and German plate makers are now taking a serious view of the situation The writer tells us that the cry is raised of German-made glass for the German plate maker, because at the present time the latter has to import his glass from Belgium or Great Britain and "to pay on it pretty nearly as much duty as is paid by the importer of the English plates' A practical illustration of the situation is summed up by the writer, who narrates that when paying a visit to a large German polytechnic, in the instruction rooms he found students being shown the making of positive transparencies on "Thomas's" plates and of carbon prints on 'Autotype" tissue

THE recent public inquiry at Dunfermline with reference to the death of a miner by an electric shock caused by a haulage rope being made alive, directs attention to the very unsatisfactory state of affairs which still exists in a large proportion of our collieries It is lamentable that the present calamity and many previous cases were due to the fact that men who have not been technically trained in electrical work are placed in charge of electrical machinery and although they may be quite practical engineers from

mining and ordinary machinery points of view, are not fitted to examine and overhaul electrical plant The question arises as to what constitutes a "competent person" within the meaning of the Mines Act (Rule 11), and the sooner this is made quite clear and insisted upon the better it will be for all concerned in electrical mining work In the present case, the engineer of the colliery and the "overman" were entruated with the machinery in question, and the evidence proves clearly that they were only expected to see that outside and surface connections were all right, and also to open up switch boxes, but any internal faults and so on were not considered to be within their responsibility Colliery managers must be made to realise that technically trained men should be employed to undertake electrical work in the colliery, and until they do so accidents are bound to occur—the only wonder being that they are not more frequent

PROF R W WOOD has sent us a description of a series of interesting experiments he has made in the direction of the optical intensification of paintings One of the difficulties an artist has to contend with in depicting scenes in which great contrasts of luminosity occur is the narrow range of luminosity obtainable on canvas with pigments Aubert states that the whitest paper is but fifty-seven times as luminous as the blackest and this probably represents about the range obtainable in paintings The problem is, therefore how to produce a strong illumination on all high lights of the picture and a feeble illumination on all the shadows Prof Wood has obtained good results by taking a photograph of the painting on an orthochromatic plate, preferably a red sensitive plate with a suitable ray filter A lantern-slide is then made from the negative and the picture projected in a dark room, not on a white screen but on the original painting Any desired effect can be secured by local reduction or intensification of the negative or lantern-slide If the negative itself is projected upon the painting a most curious effect is obtained The contrast is lessened, and if the negative is a dense one the contrast may be almost destroyed, making the painting appear a flat wash of chocolate In taking the negative care must be taken to have the painting vertical and the camera lens directly in front of the centre of the picture If after looking for a few minutes at a painting illuminated in the way described the lantern-slide is removed and a uniform illumination allowed to fall on the picture, it appears as if it had not been dusted for ten years, the sunlight leaves it, and everything looks flat Prof Wood finds that the effects are very different according to whether the negative is taken on an ordinary or an orthochromatic plate especially if there is much blue in the painting He thinks too, that if the values are correct in the original painting they will hold under the graded illumination produced by the lantern-slide, if they are not right, the errors will be glaringly magnified

No 95 of the Communications from the Physical Laboratory of the University of Leyden contains an account of a series of investigations on the measurement of very low temperatures carried out under the superintendence of Dr Kamerlingh Onnes, the director of the laboratory Mr C A. Crommelin has compared the readings obtained by a thermoelement of constantin-steel with those given by the hydrogen thermometer Mr J Clay has measured the coefficient of expansion of Jena glass and of platinum between +16° C. and −182° C., and compared the platinum resistance thermometer with the hydrogen and the gold resistance thermometer, whilst M. C Braak has made a detailed investigation of the hydrogen thermometer as a means of measuring low temperatures.

THE transformation, which was first observed by Lallemand in 1870, of orthorhombic sulphur, dissolved in carbon disulphide, into a less soluble amorphous variety under the influence of light, forms the subject of a paper by Mr G A Rankin in the *Journal of Physical Chemistry* (vol xi, No 1) The transformation is brought about by the violet and ultra-violet rays, and is reversible, the conversion of the amorphous form into the orthorhombic crystalline variety taking place when it is kept in darkness The presence of ammonia or hydrogen sulphide accelerates the latter change and tends to prevent precipitation from a carbon disulphide solution even in bright sunlight Conditions of equilibrium depending on the intensity of the light can be established between the two forms of sulphur present in solution at a constant temperature

A SECOND edition of Mr. Mervyn O'Gorman's "Motor Pocket Book" has been published by Messrs. A Constable and Co, Ltd The book has been revised and enlarged, and its price is 7s 6d net.

THE writer of the article on the "Treatment of Cancer" in NATURE of December 20, 1906, writes to say that he was in error in believing that the injections of the pancreatic enzymes have to be made in the neighbourhood of the growth (January 10, p 247) He understands that this is not the case, so an objection he raised to the trypsin treatment is removed

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN MARCH —

March 1	11h 42m	Minimum of Algol (β Persei)
,,	14h	Mercury at greatest elongation, 18° 9′ E
4	8h 31m	Minimum of Algol (β Persei)
6	22h. 26m	Conjunction of Mars with the moon, Mars 3° 13′ S
12		Venus. Illuminated portion of disc = 0·639.
16	3h	Conjunction of Vesta with the moon, Vesta, 0° 7′ N
21	6h	Sun enters Aries, Spring commences.
,,	7h 16m to 8h. 30m	Moon occults χ^1 Orionis, (mag 4 7)
,,	12h 30m to 13h. 25m	Moon occults χ^4 Orionis, mag 4 8)
,,	16h. 38m	Conjunction of Jupiter with the moon, Jupiter 2° 32′ N
24	10h 14m	Minimum of Algol (β Persei)
27	7h 3m	Minimum of Algol (β Persei)

A NEW FORM OF CŒLOSTAT TELESCOPE —One of the chief difficulties encountered in the work of the Mount Wilson Solar Observatory has been the deformation and poor definition of the sun's image, caused by the distortion of the mirrors and by the unsteadiness of the heated atmosphere through which the horizontally projected beams have to pass when reflected from the cœlostat to the spectroheliograph or spectrograph

Prof Hale now proposes to obviate some of the difficulties by having the whole instrument vertical, and in No. 1, vol xxv (January), of the *Astrophysical Journal* he describes and illustrates the form of the proposed instrument The cœlostat mirror (diameter 17 inches) is to be mounted on a steel tower some 60 feet high in such a manner that it can be moved to follow the sun without disturbing its adjustments A second mirror, elliptical in form, will again reflect the beam on to a 12-inch objectglass (60 feet focal length) mounted directly below it, and

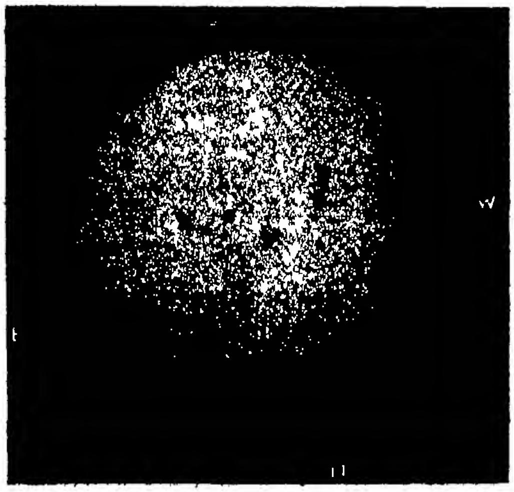
this will focus the image on to the slit of the 30-feet spectroheliograph or that of the Littrow spectrograph, both these instruments will be underground, and will therefore be preserved at a fairly even temperature

To prevent its distortion, each mirror is to be 12 inches thick, and will be silvered on both sides, and, if necessary, heated on the back by reflected or direct sunlight An electric motor will drive the photographic plate across the secondary slit of the spectroheliograph, and will by means of a vertical shaft impart a synchronous motion to the 12-inch lens, and hence to the sun's image

The Littrow spectrograph is to be fitted with an 8-inch plane grating, and will be employed in the study of the solar rotation and in the photography of sun-spot spectra

THE RECENT LARGE GROUP OF SUN-SPOTS —Another large group of sun-spots visible to the naked eye—of which the solar maximum through which we have just passed has furnished an abnormal number—was observed during the former half of the present month

The first signs of this group appeared on February 6, when two small nuclei were seen on the eastern limb about 15° south of the equator, and these were followed by two similar spots on February 8 On February 9 a larger spot brought up the rear of the group, which then contained a large number of small umbræ In London,



Photograph of sun taken oh 47m February 11, 1907

bad weather prevented the daily observation of the development of the group but on February 11 it was easily visible to the naked eye, and was seen to have developed a second fairly large spot at its preceding extremity The accompanying reproduction is from a photograph taken at oh 47m on that date, and it may be seen that the preceding spot was then the largest in the group and had a peculiar kidney-like shape The total affected area was then roughly rectangular, with a length of about 115,000 miles and a breadth of about 55,000 miles Naked-eye observations of two groups were possible on February 14 The larger group formed a striking spectacle on the western limb on February 18 but had disappeared from view when the sun was observed on the following day

THE SPECTROSCOPIC BINARY λ ANDROMEDÆ —From a number of spectrograms of λ Andromedæ, taken with the Mills spectrograph, 1897–8–9, a set of elements for the orbit of the binary has been computed by Mr Burns, of the Lick Observatory On comparing these elements with those determined from more recent spectrograms, taken with the re-mounted Mills spectrograph, it is seen that there are material differences which can only be reasonably accounted for by the supposition that the orbit itself has been modified The discrepancy, if established, will probably be found to be due to a third body in the system of this star (Lick Observatory Bulletin, No 105)

THE GROWTH OF MICRO-ORGANISMS [1]

THE author, early in the past year, began to make experiments on the origin-of-life question, with various saline solutions containing ammoniacal salts After a time he found the best results were to be obtained with one or other of two solutions, one of which contained small quantities of sodium silicate, ammonium phosphate, and dilute phosphoric acid in distilled water,' and the other a simple solution of sodium silicate with liquor ferri pernitratis in distilled water It was found, also, that with the use of these saline solutions exposure of the experimental vessels to diffuse daylight, with even a mean temperature of only 60° F to 65° F, favoured the appearance of microorganisms quite as much as, or even more than, darkness associated with an incubator temperature of 95° F

The solutions were placed in previously superheated tubes, which, after being hermetically sealed, were heated again in a calcium chloride bath to 239° F (115° C), 248° F, 257° F, or 266° F (130° C), for ten to twenty minutes, In all these tubes, after the process of heating, a small deposit, either of silica alone or of silicate of iron, was thrown down The tubes were subsequently exposed either to diffuse daylight or else in the incubator, and mostly for periods varying from five weeks to four months When opened, the tubes were found to contain in varying abundance, one or more kinds of micro-organisms, photographs of which were shown

One point of much interest in connection with these experiments is the fact that no carbon was ostensibly contained in the solutions, though its close chemical ally silicon, was always present

It had previously been determined that such solutions proved excellent nourishing media for the growth of micro-organisms, and this fact led to trials whether any evidence was to be obtained tending to show that such solutions could also actually engender living units On examination of the contents of the tubes after their prolonged periods of exposure to light or in the incubator the organisms were always found, after careful search on or within the substance of the flakes of silica, while the fluid above remained perfectly clear

Many organic compounds have been discovered by chemists in which silicon wholly or in part replaces carbon, and it is contended that there is good *primâ facie* evidence from these experiments tending to show that silicon is capable of entering into the composition of protoplasm itself —that is, wholly or in part taking the place of carbon

In regard to the major question, concerning the origin of life itself, the facts to be borne in mind are these —If a few hours after the heating of the tubes one or more of them be opened as "control" experiments and the sediment carefully examined, no organisms of any kind are to be found, but, after suitable periods of exposure organisms may be found, in more or less abundance in the sediment taken from other similar tubes Here, then, is evidence that *the organisms are living*, they have appeared and multiplied within sealed tubes, though at earlier dates none is to be found

Then again, it is important to bear in mind (1) that, apart from "spores" of bacilli, no micro-organisms can resist an exposure of two or three minutes in boiling water this being lethal for bacteria vibriones, micrococci, torulæ and moulds, and (2) that all ordinary spores of bacilli are killed by a similar exposure for a minute or two to 115° C (239° F)

It is concluded therefore, that the bacteria, bacilli vibriones, micrococci torulæ, and moulds which have been taken from hermetically-sealed tubes previously heated to 115° C 120° C, 125° C, and 130° C for ten to twenty minutes must have been engendered *de novo* within these vessels

The organisms that arise *de novo* are presumed by the author to assume well-known forms, for precisely the same reason that the various representatives of the crystalline world *when they originate*, invariably fall into their own specific shapes and with surfaces always inclined to one

1 "On the de-novo Origin of Bacteria, Bacilli Vibriones, Micrococci, Torulæ and Moulds in certain previously superheated Saline Solutions contained within hermetically sealed Tubes By Dr H Charlton Bastian F R S. Read before the Royal Medical and Chirurgical Society on January 22

another at angles that never vary for each particular species of crystal The forms in each set of cases—in organisms and in crystals alike—may be regarded as the necessary resultants of the molecular constitution of their initial units in the particular media and surroundings in which they occur

PROPERTIES OF ALLOYS[1]

THE research described in the report was carried out by the authors with the cooperation of the Broughton Copper Co, Manchester, and the British Aluminium Co, Milton, who furnished respectively the best *commercial* copper and aluminium for making the alloys, undertook the rolling and drawing of the materials, and made special castings where necessary

The salient points of the report are stated as follows —

(a) The number of alloys that have been found of any industrial and technical promise is small Such alloys are chiefly those very rich in copper At this end of the series the limit of serviceable alloys must be placed at 11 per cent At the other end of the series the limit is even smaller Among the specifically light alloys rich in aluminium the limit is probably not higher than 4 per cent of copper Between 11 per cent and 96 per cent of aluminium (exclusive) the alloys do not appear to be of any practical promise

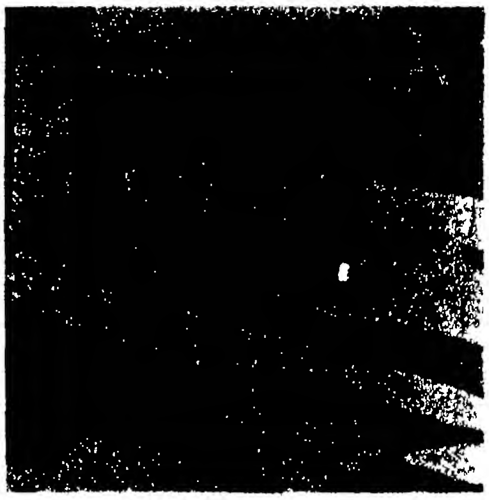
(b) But if the range of serviceable alloys is narrow, their quality is certainly high in several instances This statement holds for certain of the rich copper alloys containing between 7 per cent and 10 per cent of aluminium It is not going too far to say that in certain respects the best of them equal, and even surpass, high-quality steels of the same general character

The following summary refers only to the rich copper alloys —

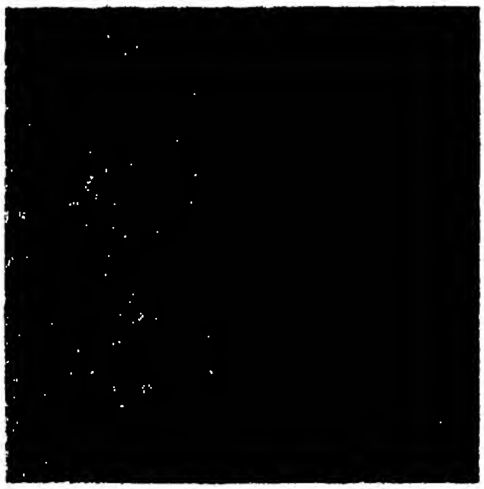
(c) Four features of the results of the tensile stress tests of outstanding interest merit a special comment

(1) In view of the doubt which exists at the present time as to whether copper and its alloys possess true yield-points, it is important to record that from 0·1 per cent to 9 per cent of aluminium the alloys possess clearly marked yield-points

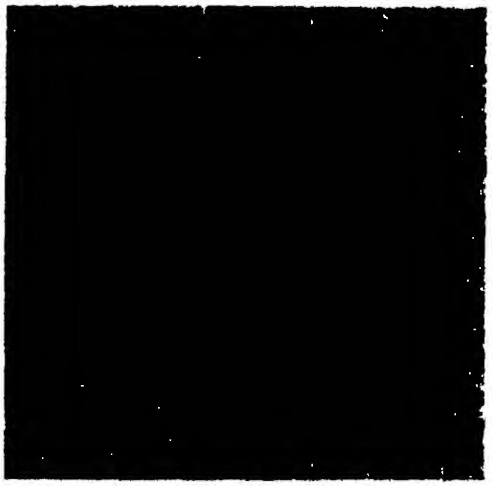
Rolled



After prolonged annealing



After a short annealing



Quenched from 900° C in water

Structures of an alloy containing { 90·06 per cent of copper / 9·90 „ aluminium.
Magnification 150 diameters

[1] Abstract of the Eighth Report to the Alloys Research Committee On the Properties of Alloys of Aluminium and Copper By Prof H C. H Carpenter and Mr C A. Edwards, of the National Physical Laboratory Read at the Institution of Mechanical Engineers on January 18

(*a*) It has been recently shown by Messrs Stanton and Bairstow (Proceedings of the Institution of Civil Engineers, 1906) that the primitive yield-point of a rolled or forged steel is usually an artificial figure, and is due to a *stiffening* caused by this mechanical treatment Such is not the case with these alloys Their primitive yield-point is the true one

(3) The ductilities (considered as a product of the percentage elongation and reduction of area) of alloys containing from 0 1 per cent to 7 35 per cent of aluminium are very high and practically constant, even although the tenacity increases markedly with rise of aluminium

(4) The tenacity and ductility of the widely-known "aluminium bronze" or "gold," containing 10 per cent of aluminium, have been found to be as good in the form of *small chill castings* as in the *rolled bar*, where an 80 per cent reduction of area of the original ingot has been effected So far as the authors have been able to learn, this result has no parallel At their request, therefore, independent tests were instituted at the Broughton Copper Works, and these have confirmed the above result which may have important practical consequences

(*d*) The research has brought to light several striking instances of the profound influence of a small quantity of aluminium upon copper, notably in the tension tests, but especially in the torsion and electrical conductivity experiments One-tenth of 1 per cent raises the angle of twist of copper in torsion 90 per cent , it lowers the electrical conductivity 23 per cent

(*e*) The behaviour in torsional stress of the alloys containing from 0 1 per cent to 7 35 per cent of aluminium is one of the outstanding features of the report

(*f*) The alloys containing from 5 per cent to 10 per cent of aluminium have come well out of the dynamic stress tests The particular merit of alloys Nos 9 and 13 when tested in alternating stress is the close approximation of the maximum stress under which they will bear an unlimited number of reversals to the stress at the elastic limit as determined in a tensile test *In this respect they are markedly superior to the iron and steel specimens hitherto investigated*

Alloys Nos 6, 9, and 13 stood up well when repeatedly stressed beyond the yield-point in Arnold's test In fact Prof Arnold has informed the authors that "Alloy No 9 constitutes a record in its capacity of resisting alternations "

(*g*) At about 15 per cent of aluminium the alloys are entitled to rank with quenched steels in *hardness* Thus the hardness number of No 17 (15 38 per cent) in the *cast* state (untreated) is 539, which is about that of a 0 45 per cent carbon steel quenched in water at 20° C (68° F), and is only slightly lower than that of a 0 66 per cent carbon steel similarly treated

(*h*) In the corrosion tests, which were purposely made as severe as possible alloys containing from 1 per cent to 10 per cent of aluminium have shown themselves to be practically incorrodible by sea-water, whether alone or bolted to a plate of mild steel In these tests they showed themselves superior both to Muntz metal and naval brass, which corroded appreciably In tap water of medium temporary hardness the positions were exactly reversed

(*k*) In view of the discussion in the previous report as to the trustworthiness of temperatures measured with a protected thermo-junction, the exact influence of the jacket (a fire-clay tube 1/16th inch in thickness) between temperatures of about 1100° C and 550° C (2012° F and 1022° F) has been determined It has been found to cause a lowering of not more than 3° C (5° 4 F) at the higher, and 9° C (16° 2 F) at the lower temperature and above 800° C (1472° F) comes *within* the experimental errors and uncertainties of the method

(*l*) Finally, a special comment must be made on the truly extraordinary similarity in physical and mechanical qualities between alloy No 13, which consists of 90 06 per cent of copper +9·90 per cent of aluminium, and Swedish Bessemer rolled steel of about 0 35 per cent of carbon and thirty-eight tons per square inch ultimate tensile stress

A PROPOSED INTERNATIONAL ATTACK ON THE SIDEREAL PROBLEM

IN a brochure[1] written by Prof J C Kapteyn, of the Groningen Astronomical Laboratory, the author outlines the chief points of a very comprehensive attack which he proposes should be made as soon as possible, on the main problems concerning the structure of the sidereal universe

Whilst the "Carte du Ciel," parts of which are now approaching completion, gives us the relative projected positions of all the stars down to the eleventh magnitude and will, by duplication after a number of years, afford material for the accurate determination of proper motions, it leaves untouched the extremely important question as to the distribution of different stellar types in actual space Prof Kapteyn proposes to supplement this enormous work by the preparation of a Durchmusterung which shall contain all the necessary data for a preliminary discussion of the structure of the universe In fact he proposes that in the same way that the geological has supplemented the geographical study of the earth, so shall an *astrological* supplement our astrographical study of the heavens, but it is obvious that to attempt a scheme like this for the *whole* of the heavens at once would be to court failure The plan would probably die of senile decay ere it showed sufficient results to have justified its existence For this reason, and acting on the advice of eminent astronomers who favour the idea of such a survey, Prof Kapteyn limits his proposals to a number of selected areas of the sky This would reduce the work immensely and would probably lead to a first approximation of the truths which it is hoped to educe

The general scheme is based on the method of "gauging" as carried out by the Herschels, only that now instead of considering simply the numbers of stars, every ascertainable fact in regard to the objects studied must be considered The chief data to be obtained as enumerated by the proposer of the scheme, are visual magnitudes photographic magnitudes, spectral types astronomical proper motions, radial velocities, and parallaxes to which list he adds the determination of the amount of light received from different parts of the sky, as being a subject of great importance to the problem under consideration

As Prof Kapteyn points out, there are already sufficient data for the brighter stars, partially excepting parallax and photographic magnitudes, to allow of a fairly thorough statistical treatment, but much of this data needs a great amount of arrangement and classification ere it can be included in a homogeneous attack The great need in such an inquiry as that proposed is the international study of the *fainter* stars Work already completed or now in hand, will take us down to the seventh or eighth magnitude for most of the elements named, but it is self-evident that, in any attempt to solve the riddle of sidereal structure, the Milky Way is an all important feature, and therefore, far fainter magnitudes than this must be included

Put into its briefest form the scope of Prof Kapteyn's proposals is —"For 206 areas regularly distributed over the sky and for another less extensive series of particularly interesting regions, to obtain astronomical data of every kind for stars down to such faintness as it will be possible to get in a reasonable time " The 206 areas first named come under the designation of "the systematic plan" and are again divided into two classes, the first of which would comprise 118, and the second eighty-eight areas These are so arranged that the first class might be completed independently of the second and would furnish sufficient data for a first approximation Then if there were evidence that this could be executed in reasonable time the second class might be intercalated without interfering with the other except to provide further data which would in all probability enhance the value of the final

[1] Plan of Selected Areas By Prof J C Kapteyn (Groninge 1906

results to an extent incommensurable with the extra labour involved

The 206 areas would include 400 square degrees of the sky, and this full scheme would entail the following labours:—The determination of the rough positions and sharply defined photographic magnitudes of some 200,000 stars, visual magnitudes for the same 200,000, the determination of the accurate proper motions, to within 0"·01 in each coordinate, of some twenty thousand of these objects. For the same twenty thousand, parallaxes are necessary, and for as many of them as is possible the class of spectrum and the radial velocities must be determined. Finally, the determination of the total amount of light received from different parts of the sky would complete a set of homogeneous data from which undreamt-of additions to our knowledge of the sidereal universe might accrue.

In addition to this "systematic plan," Prof. Kapteyn, after much correspondence and discussion with a number of eminent astronomers, has decided on a scheme for the elucidation of "special areas." This scheme includes forty-six areas such as those in the Milky Way which show intense variations of star-density, the rifts and branches of the Milky Way, and extra-galactic areas where nebulæ or strong contrasts in star-density are preponderant.

Many interesting devices to further the plan are discussed by Prof. Kapteyn, e.g. the determination of colour, and hence the probable spectrum class, from the comparison of the photographic and visual magnitudes in the cases where the stars are so faint that these features cannot be determined by the usual methods; again, the determination of proper motions and parallaxes from plates exposed a second time after an interval of some years. Possibly Prof. Wolf's stereo-comparator method of determining proper motions would materially curtail the interval necessary between the two exposures.

Considering a few details, it is seen that the scheme includes:—(1) 9710 exposures on 2620 plates, in addition to the plates for the determination of the radial velocities of three or four standards in each area. (It is intended that the bulk of the radial velocities shall, if possible, be determined by one of the wholesale prismatic-camera methods such as those proposed by Herr Orbinsky, Prof. E. C. Pickering, and Prof. Comstock.) (2) Visual observations of 3024 standard magnitudes, the determination of the magnitudes and positions of 200,000 stars, and the meridian observations of some 2600 stars for proper-motion standards. (3) The measuring of nearly 1½ million images.

Prof. Kapteyn, with all his experience, is quite ready, should the essential funds be forthcoming, to undertake a greater part of the measuring work, and could, at present, undertake to perform half his proposed share. A number of other well-known astronomers, as may be seen from the letters which he publishes at the end of his brochure, are definitely and enthusiastically in favour of the project, and are willing to grant what aid is in their power, so that the scheme cannot be looked upon as immature or as entailing insuperable difficulties.

Accepting for the moment that the plan, in its entirety, is feasible, the *possibilities* attached to the discussion of the results are obviously infinite. In some fifty or a hundred years the "Carte du Ciel," if repeated, will probably afford a series of definitive proper motions which can then be discussed from the sidereal structure standpoint, but of the spectral layers in the visible universe it would leave us in almost total ignorance. On the other hand, the results from Prof. Kapteyn's plan would probably afford all the information attainable by human effort of the sidereal strata or groups, or drifts, or a thousand and one other features.

As an earnest of what might accrue from such a discussion, one may cite the remarkable result recently derived by Mr. Eddington from the analysis of the relatively meagre data of the Greenwich-Groombridge proper motions (see Nature, No. 1938, p. 182, December 20, 1906), a result first derived, in a qualitative form, by Prof. Kapteyn himself from a discussion of the Bradley proper motions.

W. E. Rolston.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—At a meeting of members of convocation in Magdalen College on February 23, which had been summoned by the Vice-Chancellor to consider the election of a Chancellor of the University, there seemed to be a majority in favour of the nomination of Lord Curzon.

The published accounts of the common university fund for 1906 show that the income for that year was 6937*l*., and the expenditure 6395*l*., of which sum 3577*l*. was devoted to scientific objects.

Cambridge.—The Smith's prizes have been awarded for the following essays:—"Fluorescence," G. R. Blanco-White; "The Systematic Motions of the Stars," A. S. Eddington; "The Bending of Waves Round a Large Opaque Sphere and some Associated Problems," J. W. Nicholson; "The Variation of the Absorption Bands in the Spectrum of a Crystal under the Action of a Magnetic Field," W. M. Page. The names are arranged in alphabetical order. The essay on "Some Problems on the Diffraction of Electric Waves," by H. J. Priestley, is awarded honourable mention.

H. R. Hassé has been elected to the Isaac Newton studentship, tenable from April 15, 1907, to April 15, 1910. The student will carry on a course of research in physical optics.

W. Spens has been elected fellow at Corpus Christi College, and has also been appointed director of natural science studies in the college.

Dr. Harmer, the superintendent of the Museum of Zoology, announces the receipt of a cast of a skeleton of *Diprotodon australis*, presented by Dr. E. C. Stirling, F.R.S., director of the South Australian Museum at Adelaide. Dr. Harmer also records the gift of a valuable consignment of some nine skeletons and forty skulls and skins of mammals, mostly antelopes, from tropical Africa, presented by Mr. C. B. C. Storey, of Clare College.

The Cavendish Laboratory Extension Syndicate has proposed plans for the new laboratory running along Free School Lane, which will cost between 7000*l*. and 8300*l*. Towards defraying the cost of this building there is available Lord Rayleigh's gift of 5000*l*. out of the Nobel prize, and Prof. Thomson is able to find 2000*l*. from the laboratory funds.

The recommendation of the general board of studies that a university lecturer in pathology be appointed, in connection with the special board for medicine, with an annual stipend of 100*l*. payable out of the common university fund, will be brought before the Senate on March 9.

It is proposed to nominate Prof. A. Thomson to be a member of the board of electors to the professorship of anatomy; Sir E. C. Perry, a member of the board of electors to the Downing professorship of medicine; Prof. Graham Kerr, an elector to the professorship of zoology; Dr. Anderson, an elector to the chair of physiology; Prof. Middleton, an elector to the Drapers' professorship of agriculture; and Prof. Langley, to that of botany.

The local examinations and lectures syndicate has appointed E. A. Parkyn and D. H. S. Cranage as delegates at the International Congress on School Hygiene to be held in London in August.

Mr. J. J. Lister has been appointed a manager of the Balfour fund until June, 1909, in succession to the late Sir Michael Foster.

Mr. F. A. Potts has been nominated to occupy the University table at the laboratory of the Marine Biological Association at Plymouth for one month during the ensuing Easter vacation.

The Mercers' Company has made a donation of fifty guineas, and the Grocers' Company one of ten guineas, to the South-Eastern Agricultural College.

At the South-Western Polytechnic on March 15 the Lord Alverstone, G.C.M.G., Lord Chief Justice of England, will present prizes and certificates to students of evening classes and of the day college.

THE Goldsmiths' Company has undertaken to provide the 8000l. required for the completion of the new wing of Goldsmiths' College at New Cross The site and buildings were presented by the company to the University of London for educational purposes in 1904.

THE treasurer of Guy's Hospital has received a bequest of 1000l. under the will of the late Dr C J Oldham, of Brighton, for the purpose of endowing an annual prize in ophthalmology at the medical school A further anonymous donation of 200l has also been received for the fund of the endowment of medical education and research

MR. HAROLD HILTON has been appointed lecturer in mathematics at the Bedford College for Women (University of London) Mr Hilton is a former fellow of Magdalen College, Oxford, and has for the past five years been on the teaching staff of the University College of North Wales He is the author of a treatise on the mathematical theory of crystallography, and of numerous papers published in the Proceedings of the London Mathematical Society and elsewhere

SINCE the disastrous fire which partially destroyed the main building of the Merchant Venturers' Technical College, Bristol, in October last, various sites for the re-erection of the college have been suggested and carefully discussed A report advising the retention of the present site was adopted by the Society of Merchant Venturers on Friday last, and steps will, therefore, be taken at once to replace the various laboratories, workshops, lecture theatres, &c, with all possible speed In framing plans for re-building, the Merchant Venturers will bear in mind the possibility that at some future period the college may be called upon to take its proper part in the formation of the proposed University of Bristol

THE Board of Education has issued a return showing the extent to which, and the manner in which, local authorities in England and Wales have applied funds to the purposes of technical instruction and other forms of education other than elementary during the year 1904–5 The total number of authorities having powers in respect of education other than elementary was, for the year under consideration 1203; of these sixty-three were county councils, seventy-one county borough councils, and the remainder councils of non county boroughs or urban districts All the county councils and county borough councils, and 431 of the councils of non-county boroughs or urban districts, incurred expenditure for higher education Particulars are provided as to money spent upon secondary schools, including pupil-teacher centres, evening schools and institutions for higher and technical education, exhibitions including payment of fees, salaries for administrative officers, legal expenses and general administration, and in respect of loans The total expenditure in England and Wales on higher education, understood as including the work of institutions mentioned, was, in 1904–5, 2 889,871l The amounts under the more important headings were —secondary schools, 736,966l, evening schools and institutions for higher and technical education, 1 382,162l, exhibitions 248,007l, training of teachers, 48,835l administrative and legal expenses 152,605l The detailed information provided in the tables should prove of great value to members of education committees desiring to compare the expenditure in their own districts with that in other areas

MR McKENNA, President of the Board of Education, addressed a letter on February 19 to Sir Francis Mowatt the first chairman of the departmental committee on the Royal College of Science, concerning the proposed Imperial College of Applied Science at South Kensington, to the delay in the inauguration of which we referred last week Mr McKenna says that the time which has elapsed since the appearance of the committee's report has not been wholly wasted, because the problem has become clearer and the institutions concerned have become more nearly agreed as to the necessities of the case After reviewing the alternative courses pressed upon the consideration of the Board of Education, the president expresses the opinion maintained in these columns that the points of determinative importance in the whole situation now is that there should be no further avoidable delay in bringing about the establishment of the new institution The gratifying announcement is then made that the King is to be petitioned for a Charter for the new institution on the lines unanimously recommended by the departmental committee in January, 1906, and set forth in the draft proposals circulated by the Board of Education last July The special governing body suggested by the departmental committee is to be appointed forthwith, and the institution to be developed as soon as possible Mr McKenna concludes his letter by requesting Sir Francis Mowatt to intimate to the Senate of the University of London that after an interval of time sufficient to permit of the full development of the governing body for the new institution, he will be prepared to advise the appointment of a Royal Commission to consider whether the amalgamation of the new institution with the University of London is desirable and feasible

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 13, 1906 —"Further Observations on the Effects produced on Rats by the Trypanosomata of Gambia Fever and of Sleeping Sickness" By H G **Plimmer** Communicated by Dr C J Martin, F R S

From the results of 211 experiments, extending over a period of nearly three years, it appears that the tentative deductions which the author made in his preliminary note (Roy Soc Proc, vol lxxiv) from the few experiments therein recorded, that Gambia fever and sleeping sickness are two distinct diseases, cannot be maintained

This extended series of experiments and observations goes to show that each of these two strains of Trypanosomata has produced two different effects in the same class of animals, under conditions of which we at present know nothing, that these effects are alike for the two organisms, and that the Trypanosomata found in these two types of disease are one and the same organism, modified by passage from man through monkeys to rats and perhaps in the strains used by the author, by transplantation into animals of, and in another country

Faraday Society, January 29 - Prof H E Armstrong, F R S, in the chair -- Discussion on osmotic pressure opened by the **Earl of Berkeley,** who exhibited and described his apparatus for the direct measurement of osmotic pressure The ordinary direct method of measuring osmotic pressures is to obtain equilibrium on the two sides of the semi-permeable membrane by means of the pressure of a head of liquid The method devised by the author and Mr E G J Hartley substitutes mechanical pressure, which is put straight on to the solution and equilibrium thus obtained A vapour-pressure method for measuring osmotic pressure was also described —Indirect methods of measuring osmotic pressure W C Dampier **Whetham** The speaker agreed as to the importance of the vapour-pressure method He discussed the formula used by Berkeley and Hartley and explained the difference between it and the van 't Hoff formula obtained from thermodynamic considerations, the expressions being identical where there is no change of volume of the solvent as it enters the solution --Osmotic pressure from the standpoint of the kinetic theory Dr T M **Lowry.** The application of the equation $PV = RT$ to the osmotic pressure of gases could be predicted on general theoretical grounds, but there was no *a priori* reason for supposing that it would be applicable to the case of liquids In the early years of the osmotic discussion it had been assumed by van 't Hoff and others that since osmotic pressures and gas pressures could be calculated by means of the same formula the conditions must be identical in the two cases and it was definitely stated that in dilute sugar solutions the osmotic pressure was wholly due to the bombardment of the membrane by the molecules of the sugar the effects produced by the water molecules being substantially identical on either side of the membrane The alternative view that osmotic pressure represented a diminution in the activity or "active mass" of the solvent was suggested by Poynting in 1896 and had sub-

sequently been advocated by Armstrong, Beilby van Laar, and others The simplest case of a semi-permeable membrane is undoubtedly to be found in the surface of separation between liquid and vapour At such a surface the kinetic theory postulates a continual interchange of molecules between the two phases But whilst the rate of escape or evaporation would be reduced by the presence of non-volatile molecules in the surface, the rate of condensation would be unaffected, and equilibrium could only be restored by decreasing the vapour pressure, and so diminishing the rate of condensation at the surface of the solution In this case a quantitative relationship could be deduced —The bearing of actual osmotic experiments upon the conception of the nature of solutions Prof L **Kahlenberg** The occurrence of osmosis and its direction and extent are determined by the nature of the septum and of the liquids that bathe it Experiments have shown, too, that there is always a major and minor current present following in opposite directions, although it often appears as if the osmotic process were one sided In this case the septum is termed "semi-permeable," and recent research has centred around so-called semi-permeable membranes which really do not exist The author has demonstrated that it is peculiarly strong selective action on the part of the septum which causes it to be approximately semi permeable in certain cases and he has recently even succeeded in separating two colloidal substances by dialysis This selective action is due to the solubility or insolubility of the substances concerned in the membrane, and therefore osmotic pressure is due to the same forces—essentially chemical in character in the opinion of the author—as the process of solution, and they may be quite variable as different septa and different liquids are employed The usually accepted "sieve theory" is untenable because larger molecules frequently go through a membrane more readily than smaller molecules —Tables containing a summary of the recent experiments made with glucose and cane-sugar H N **Morse.** The conclusions arrived at are —(1) In the vicinity of 20° the osmotic pressure exerted by either is equal to that which a molecular equivalent quantity of a gas would exert if its volume were reduced, at the same temperature to the volume of the solvent in the pure state (2) Between 18° and 26°, at which the measurements were made both cane sugar and glucose in solution are in the anhydrous condition Measurements made just above 0° yield pressures somewhat above the calculated gas pressures Measurements with electrolytes are about to be made in which osmotic pressure and dissociation will be determined simultaneously

Entomological Society, February 6 —Mr C O Waterhouse president, in the chair —*Exhibitions* —L A **Cockayne** A collection of Lepidoptera made at Tongue, North Sutherlandshire between June 30 and July 13, 1906, comprising many species not hitherto reported from the county The several species showed little tendency to melanism —Dr T A **Chapman** Specimens of *Hastula hyerana*, Mill to demonstrate how it may vary towards melanism in the circumstances of late or retarded emergence —Miss M E **Fountaine** Examples of Anthocharid and Melitaeid butterflies from various localities in the Palæarctic regions showing a wide range of variation —The **President** A female example of the genus Dorylus from Mengo in Uganda and one small and two large workers, which would probably be the means of identifying the species The workers closely resemble specimens in the museum named *D arcens* which are said to be the same as *nigricans* —Rev F E **Lowe** Various aberrant forms of Swiss butterflies, including *Melanargia galatea*, ab *fulvata*, Lowe, from Martigny *Lycaena arion*, from Pontresina, with the black markings on the underside of the wings almost entirely absent, save one very large kidney-shaped spot, slightly tinged with white at the centre of each wing and a pair of *Pieris napi*, var *bryoniae*, taken *in cop* at Caux the ♂ not only suffused as in *bryoniae*, but also having the ♀ markings —Colonel Charles T **Bingham** The pupa of a Tineid moth, probably of the genus Brinsitta, from Upper Burmah presenting with its surroundings a remarkable mimetic resemblance to the head and body of a snake, and a case showing the curious habit of butterflies of the genera Gerydus and Allotinus attending with ants on Aphidæ for their sweet exudations —Rev F D **Morice** A very remarkable gynandromorphous specimen, from Silchester, of the common fern-visiting sawfly, *Strongylogaster cingulatus*, the dividing line between the ♂ and the ♀ portions running longitudinally, not transversely, from end to end of the creature, a form probably unique —*Papers.*—Notes on the Indo-Australian Papilionidæ Percy I **Lathy.**—The hymenopterous parasites of Coleoptera E A **Elliott** and Claude **Morley.**

Geological Society, February 6 —Dr J E. Marr, F R S, vice-president, in the chair —Note on the cervical vertebra of Zeuglodon from the Barton Clay of Barton Cliff (Hampshire) Dr C W **Andrews.** The author gives a brief description of a cervical vertebra from the Barton Clay of Barton Cliff It is referred provisionally to *Zeuglodon wanklyni*, a species described in 1876 by Prof H G Seeley The skull on which this description was founded is totally lost, so that this vertebra is the only bone of a Zeuglodon from the Barton Clay, and, with the possible exception of a vertebra from the Brockenhurst beds (which is the type of *Balaenoptera juddi*), the only one found in the British Isles that now exists —The origin and age of the plateaus around Torquay A J **Jukes-Browne.** The existence of high-level plains or plateaus near Torquay has long been known, but since Pengelly's time little attention seems to have been paid to them Pengelly believed that there were several such plains at different levels, and thought that the time of their production was not very remote On examination, however, his evidence breaks down, and the author regards the plateaus as portions of one inclined plain The age of the planation is shown to be post-Permian, by the fact that Permian breccia forms part of the plateau-surface at St Marychurch It is also probably post-Cretaceous because Cretaceous planation is not likely to have removed all the Permian Its present dissected condition shows that it is older than the Pleistocene, and consequently an Eocene date would agree with local evidence

Linnean Society, February 7 —Lieut Colonel Prain, F R S vice president in the chair —Some observations of climbing plants Rev John **Gerard,** S J The author began by pointing out the two opposing methods of describing spiral growth or torsion as viewed from the exterior or from the interior of the spiral, the result being that the "dextrorse" of the first is the "sinistrorse" of the second method With or against the sun, which applies to the northern hemisphere, is reversed in the southern hemisphere, and for these reasons he preferred to use the terms "clockwise" and "counter-clockwise" (shortened to "counterwise") the honeysuckle (*Lonicera Periclymenum*) and the hop (*Humulus Lupulus*) turning clockwise, and the convolvulus (*Convolvulus arvensis*) and the scarlet-runner bean (*Phaseolus vulgaris*) twining counterwise He showed the result of some experiments he had made by growing scarlet-runner beans in opaque cylinders to discover, if possible whether the deviation of the twist were innate, or from the direction of the light, the conclusion being drawn that the plant possessed an inclination resembling the instinct of animals, of proceeding in a given direction and resented any attempt to force it otherwise The author concluded with some observations on the behaviour of tendrils as those of *Bryonia dioica*, displaying one specimen which had varied the torsion four times, and showed ten turns in one direction against seventeen in the contrary —New plants from Malaya. Dr Otto **Stapf** The author gave the history of his new genus Hallieracantha, which receives eight species from the genus Ptyssiglottis, Hallier f, and eleven others are added from the Kew collections, they form a very homogeneous group, are eminently shade-loving plants, and exhibit anisophylly in a very marked degree The headquarters of the genus are in Borneo —Tertiary Foraminifera of Victoria The Balcombian deposits of Port Phillip F **Chapman.**

Physical Society, February 8 —Prof J Perry, F R S, president, in the chair —Annual general meeting —Presidential address Prof **Perry.** In concluding his address, Prof Perry remarked that a standard boy should know decimals at eight, he should use squared

paper to record his own experimental results at nine, he should solve interesting problems using squared paper and logarithms and tables of sines and cosines at the age of ten and eleven, and he should get the notion of a rate long before he was twelve. He would have an elementary knowledge of the infinitesimal calculus before he was fourteen. He considered the elementary use of the calculus, and even the solution of easy differential equations, a school and not a university subject. Spherical harmonics and Bessel functions and their use in all sorts of physical problems with actual curve drawing was an undergraduate study. Permutations and combinations and the theory of probability were post-graduate subjects, like the study of the fifth book of Euclid.—The magnetic field and inductance coefficients of circular, cylindrical, and helical currents: A. **Russell**. The author gives formulæ for the magnetic force near a circular current which can be readily evaluated. He then shows how the self-inductance of a ring of wire and the mutual inductance between two coaxial circular filaments can be found without using Neumann's theorem. By Kelvin's method, the results obtained can be applied at once to the corresponding problem of the simple vortex filament in hydrodynamics. In this way expressions are found for the velocity of translation of a circular vortex filament—about which there appears to be uncertainty in hydrodynamical theory—and for the energy of the motion. The exact formula for the mutual inductance between a cylindrical current sheet and a coaxial helical filament of current is obtained. It is expressed both in terms of elliptic integrals and in the form of an algebraical series.

MANCHESTER.

Literary and Philosophical Society, December 11, 1906.—Mr. Francis Nicholson in the chair.—The discovery by Butschli of strontium sulphate as the basis of the skeleton in certain Radiolaria (Acantharia): Dr. F. W. **Gamble**. Working with material brought back by the German Antarctic Expedition, and also upon Mediterranean Acantharia, Butschli has shown that strontium sulphate is the material of which the complex rods and spicules of these Radiolaria are composed. This is the first time that strontium has been described in animal tissues, and coincides with the recent discovery of barium sulphate in certain other deep-sea Protozoa (Xenyophophoridæ).—The parichnos in the Lepidodendraceæ: Prof. F. E. **Weiss**. This somewhat problematical organ appears as two small marks on the leaf scars of Lepidodendron and Sigillaria. It is found to consist of a thin-walled tissue communicating with the interior of the stem, and has been regarded by some as concerned in the transpiratory function of these extinct plants. Prof. Weiss brought forward arguments in favour of comparing them to the breathing pores of trees known as lenticels.—The structure of Syringodendron, the bark of Sigillaria: Miss K. H. **Coward**. An account was given of a particular instance of the above-mentioned breathing pores in Sigillaria.

January 15.—Sir W. H. Bailey, president, in the chair.—The positions of Mendeléeff's groups of chemical elements: C. E. **Stromeyer**. With the help of an empirical formula, which, like Stoney's logarithmic spiral of the cube roots of the atomic weights, gives average results, the author has calculated the mean positions of the various chemical groups, and finds that they are not equidistant, but are irregularly spaced like the musical notes of the major or minor scale. Dividing the iron groups into three, viz. iron, nickel, and cobalt, the chief irregularities may be summarised as follows:—The manganese and the iron groups, as well as the nickel and cobalt groups, fall nearly together, viz. 6·64, 6·82, and 7·59, 7·80, whereas the oxygen and fluorine groups, the cobalt and sodium groups, and the magnesium and aluminium groups are separated from each other by about one and a half average group intervals, viz. 5·27, 6·64, and 7·80, 9·29 and 9·82, 11·37. By assigning their mean positions to the groups, instead of the whole numbers (one to sixteen) as has been done previously, the author's empirical formula expresses very accurately the atomic weights, the chief discrepancies being found amongst the recently discovered rare elements and amongst the sulphur group. The conclusion arrived at by the author is that the atomic weights cannot be expressed by a single continuous curve, even if irregular positions are assigned to the groups.

January 29.—Mr. Francis Nicholson in the chair.—A confusion of two species of Lepidodendron (*L. Harcourtii*, Witham, and *L. Hickii*, sp. nov.) under *L. Harcourtii*, Witham, in Williamson's nineteenth memoir, with a description of *L. Hickii*, sp. nov.: D. M. S. **Watson**. In his nineteenth memoir, Williamson describes several stems as *L. Harcourtii*, Witham. Examination of these sections has shown that whilst one is probably *L. Harcourtii*, the majority belong to a type which differs from *L. Harcourtii*, Witham, in several particulars.—A collection of mammals made by Mr. S. A. Neave in Rhodesia, north of the Zambesi, with field notes by the collector: R. C. **Wroughton**.

PARIS.

Academy of Sciences, February 18.—M. Henri Becquerel in the chair.—The president announced the death of M. Marcel Bertrand, member of the section of mineralogy.—Researches on the combinations between carbon and free nitrogen: M. **Berthelot**. When acetylene is decomposed by electric sparks there is no trace of the reverse reaction, the formation of cyanogen from its elements. The author holds that there is no conclusive evidence that carbon and nitrogen combine directly at any temperature, observations to the contrary are due to the impurities in the carbon or nitrogen.—Some catalytic reactions effected under the influence of wood charcoal: Georges **Lemoine**. At a temperature of 350° C. wood charcoal causes the decomposition of alcohol into hydrogen and aldehyde. Hydrogen peroxide is freely decomposed into oxygen and water at low temperatures, and the reaction between iodic acid and oxalic acid is also accelerated by charcoal.—Remarks on the spectroheliograph: G. **Millochau**. Commenting on a recent paper by MM. Deslandres and Azambuja, the author directs attention to the spectroheliograph described by him in conjunction with M. Stefánik two years ago, and gives fuller details of the arrangement.—The theory of gases and globular clusters: H. v. **Zeipel**. An application of the theory of gases to the study of the distribution of stars in globular clusters.—A simple apparatus reproducing all the peculiarities of Foucault's experiment on the rotation of the earth: G. **Blum**.—Quasi-integral and quasi-meromorphic functions: Edmond **Maillet**.—The growth of integrals of differential equations of the first order: Pierre **Boutroux**.—The construction of a radius of curvature of the curves enveloped in the most general movement of a solid body: G. **Kœnigs**.—The variation of the vapour pressure as a function of the pressure and the determination of the ebullioscopic constants: Georges **Baume** and D. F. **Tsakalotos**.—Some molecular combinations of metallic halides with organic compounds: V. **Thomas**. The reaction between certain metals such as zinc, aluminium and magnesium is accelerated by organic substances, such as ether or alcohol. The author has made a systematic study of the various classes of organic substances capable of inducing this reaction. Besides ether and alcohol, the fatty ketones, the diketones, and nitriles all induce the reaction. The aromatic ketones, on the other hand, paraldehyde and certain aromatic aldehydes, are without effect. These effects are traced to the formation of molecular compounds of the type $CH_3CO.CH_3.MgI_2$.—Note concerning the estimation of gold by the wet method in auriferous sands: Albert **Fournier**. The presence of iron is the main difficulty in the estimation of gold in the wet way; the method described shows how this difficulty can be avoided.—The reducing and catalytic power of amorphous carbon towards alcohols: J. B. **Senderens**. Finely divided carefully purified animal charcoal was used in the experiments. At 400° C. ethyl alcohol gives ethylene and methane with small quantities of hydrogen, carbon monoxide and dioxide. With propyl alcohol, the gases contained propylene (88 per cent.), ethane, with small quantities of hydrogen and carbon monoxide. Fine sand exerts a stronger catalytic action than charcoal, and may be used with advantage in the preparation of certain ethylenic hydrocarbons. Red phosphorus at 200° C. to 240° C. induces this catalysis even better than sand.—The migration of the soluble principles in the plant: G. **André**.—

Transformations in the organism and elimination of formic acid and the formates C **Fleig**. In the intestines the formates can be converted into carbon dioxide, hydrogen, and a carbonate, chiefly by microbial action In the veins there is probably an oxidation of a diastatic nature —The brusque character of the activation of the pancreatic secretion by calcium salts C **Delezenne**.—Viviparous Diptera of the family of the Muscidæ with larvæ sometimes parasitic, sometimes vegetarian J Künckel **d'Herculais**.—Histolysis without phagocytosis, of the vibratory muscles of flight in queen ants Charles **Janet**. —The fructification of pathogenic fungi in the interior of human tissues Charles **Nicolle** and M **Pinoy** — Fundamental differences in the mechanism and evolution of the increase of resistance to infection according to the methods utilised MM **Charrin** and **Lévy-Franckel**. From experiments on rabbits it is concluded that antidiphtheric serum behaves as a drug, the effects of which pass off, as it only acts during the time of its presence, the organism remaining inert The toxin, on the contrary, causes a reaction on the part of the tissues, which, once set up, confers a new property on the cells which is more durable —Researches on the transplantation of nerve ganglions G **Marinesco** and M **Goldstein**.—Studies on the mechanism of the destruction of nerve-cells in old age and the pathological states M **Manouélian**. From the experiments given in detail the author concludes that in old age, as in pathological states, the nerve-cell undergoes similar changes In the normal state the satellite cells play an important function in the ordinary working of the nerve-cell but in old age these satellite cells exhibit a remarkable vitality, they multiply, attack the nerve-cell penetrate its interior and destroy it —The different modes of volcanic activity in the chain of the Puys Ph **Glangeaud**.—The sea floor between Madagascar, Réunion, and Mauritius J **Thoulet**.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 28.

ROYAL SOCIETY, at 4 30 — On the Dispersion in Artificial Double Refraction Dr L. N G Filon —The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes A. A Campbell Swinton —The Theory of Correlation for any Number of Variables, treated by a New System of Notation G Udny Yule

FRIDAY MARCH 1.

INSTITUTION OF MECHANICAL ENGINEERS, at 8 —Discussion continued by Sir William H White, K.C B., on the Eighth Report to the Alloys Research Committee on the Properties of Alloys of Aluminium and Copper Prof H C H Carpenter and C A. Edwards. (Prof Carpenter will reply to the Discussion)

GEOLOGISTS' ASSOCIATION, at 8 —A Geologist's Impressions of Mexico M M Allorge.

SATURDAY, MARCH 2

ROYAL INSTITUTION at 3.—Röntgen, Kathode, and Positive Rays Prof J J Thomson, F R S

MONDAY, MARCH 4.

VICTORIA INSTITUTE, at 4 30.—Orissa, its History and People C W Odling

SOCIETY OF CHEMICAL INDUSTRY, at 8 —Exhibition of a Gas Calorimeter Prof. C V Boys, F R S —Four Years' Experience in Metering Producer Gas, and continuously recording its Calorific Power Prof R Threlfall, F R S

TUESDAY, MARCH 5

ROYAL INSTITUTION at 3 —The Visual Apparatus of Man and Animals Prof William Stirling

SOCIETY OF ARTS, at 4 30.—British Malaya Sir W H Treacher, K C M G

INSTITUTION OF CIVIL ENGINEERS, at 8 —*Continued discussion* —On the Limits of Thermal Efficiency in Internal-Combustion Motors Dugald Clerk —*Paper*:—The Construction of Overhead Electric Transmission Lines A P Trotter

ZOOLOGICAL SOCIETY, at 8 30.

WEDNESDAY, MARCH 6.

SOCIETY OF ARTS, at 8 —The Discovery of the South-eastern Coalfield: Prof. W Boyd Dawkins, F R S

ENTOMOLOGICAL SOCIETY, at 8.—The Life History of *Tetropium gabrieli*, Weise: Rev G A Crawshay —Revision of the Chelisochidæ and Forficulidæ Malcolm Burr —Descriptions of some New Butterflies from Tropical Africa Hamilton H Druce.

SOCIETY OF PUBLIC ANALYSTS, at 8 —The Disposition and Analyses of Sewage Matters deposited on Superposed Surfaces W. J Dibdin.—The Composition of Milk H, Droop Richmond —Preservatives in Milk and Milk Products, (1) The Souring of Milk and the Effect of Preservatives thereon. (2) Notes on the Detection and Estimation of Preservatives H Droop Richmond and E H Miller

THURSDAY, MARCH 7.

ROYAL SOCIETY, at 4.30.—*Probable Papers*:—Experiments with Vacuum Gold Leaf Electroscopes on the Mechanical Temperature Effects in Rarefied Gases Dr J. T Bottomley, F.R.S., and F A. King.—On the Resistance of Air A Mallock, F.R.S.—Electric Furnace Reactions under High Gaseous Pressures R S. Hutton and J. E. Petavel.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Chaulmoogric and Hydnocarpic Acids M. Barrowcliff and F. B. Power.—Volume Changes which accompany Transformations in the System $Na_2S_2O_3$, $5H_2O$: H M Dawson and C. G Jackson.

AERONAUTICAL SOCIETY, at 8 —Wings v. Screws: Colonel J D Fullerton, R.E.—The Free Lever in the Flying Machine Herr Karl Milla.—Theory of Sailing Flight José Weiss.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Transmission of Electrical Energy by Direct Current on the Series System J S. Highfield

LINNEAN SOCIETY, at 8 —On the Development of the Frog: Miss N. F Layard —Biscayan Plankton, Decapoda, S B Kemp.—A Special Point in the Colour Adjustment of Chameleon: Prof E. B Poulton, F R S.—New Channel Island Plants G Claridge Druce.—*Exhibitions*: Specimens of *Nitella ornithopoda*, A. Br: H and J Groves.—(1) Probate of the Will of Richard Anthony Salisbury, (2) Manuscripts of Dr. W. J. Burchell Prof. E. B. Poulton, F R S

CIVIL AND MECHANICAL ENGINEERS SOCIETY, at 8.—Types of Enclosed Steam Water Heaters C R. Allenby

FRIDAY, MARCH 8

ROYAL INSTITUTION, at 9.—Certain Seasonal Diseases of the Sheep, and the Means of Preventing Them: Prof D J Hamilton

PHYSICAL SOCIETY, at 8 —The Rate of Recovery of Residual Charge in Electric Condensers: Prof Trouton and Mr Russ.—Experimental Mathematics Mr Pichon —An Instrument to describe Families of Equiangular Spirals Mr Blakesley —A Micromanometer: Mr Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8 —Corrugations on Tram Rails A. T Arnall

MALACOLOGICAL SOCIETY, at 8 —On the Non-Marine Mollusca of the Mylne Collection: A S Kennard and B B Woodward.—Notes on Holocene Mollusca from Ightham: A S Kennard and B. B Woodward —Descriptions of Four New Species of Melania from New Ireland and Ke-lan tan H. B Preston —On the Arms of the Belemnite: G. C. Crick.

SATURDAY, MARCH 9

ROYAL INSTITUTION, at 3 —Röntgen, Kathode, and Positive Rays Prof. J J Thomson, F R S

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THURSDAY, MARCH 7, 1907

SIR CHARLES BUNBURY.

The Life of Sir Charles J. F. Bunbury, Bart With an Introductory Note by Sir Joseph Hooker, C B, G.C.S.I. Edited by his Sister-in-law, Mrs Henry Lyell. With portraits and illustrations 2 vols Vol. i., pp x+371; vol ii, pp v+411 (London: John Murray, 1906) Price 30s. net

SIR CHARLES BUNBURY was a naturalist of the old school; his chief interest, so far as science was concerned, was in botany and geology, his published papers being almost confined to palæobotany He was an industrious diarist and letter writer, and having travelled extensively in Europe, South America, and Africa, he saw much worthy of record He had an inexhaustible interest in all that is best worth seeing and knowing, interesting people, and all the aspects of nature and art, were industriously sought out and described. But it is on the lovable personality revealed in his letters and diaries that the attractiveness of the book in large measure depends He seems to have been the most patient and even-tempered of travellers, his diaries hardly contain a querulous word He may claim the sundial's motto, "Horas non numero nisi serenas" He was fond of summing up the characters of those whom he met, and these notes, without being unduly laudatory are free from any trace of ill-nature These acute and genial sketches are, to our thinking, the best part of the book The picture which he unconsciously gives of himself is that of a man of breeding and unpretentious distinction, a man one would imagine of quiet dignity, with a simple and direct nature and an affectionate heart He observed well and described things pleasantly, his only fault as a correspondent seems to have been his lack of humour, but of this we need not complain, for there are no flat remarks intended for witticisms, nor is there anything that rings false or "smart" in his quiet, easy style

The present volumes are an abbreviation of a fuller version privately printed some years ago, unfortunately, the process of compression has not been sufficiently thorough Much as we respect and like Sir Charles, we do not want a minute itinerary of his boyish travels, though we might have liked a paragraph showing at how early an age he was alive to the beauty and interest of the world In the letters of his later life we find the same want of compression by the editor Most of us are easily satiated with descriptive letters from abroad, and there is in these volumes a good deal of this class of writing which might well have been omitted In other respects the editing of the book shows some conspicuous merits, especially in such details as biographers are apt to neglect The volumes are well printed, they are pleasantly light in the hand, and the pages are cut The date of Sir Charles's birth is given in the proper place, viz., the first line of the book, and lastly there is a full and carefully compiled index

A large number of letters are addressed to his father and to his stepmother His strong affection and respect for his father are expressed in a touching letter written in his forty-seventh year (ii, 87). After his marriage to Miss Horner, his father-in-law, Leonard Horner, his sisters-in-law, and his brother-in-law, Charles Lyell, all became regular correspondents

Lyell seems to have consulted him on botanical matters and to have written fully to him on geological questions suggested by his own researches We thus get some insight into Lyell's point of view when he was making up his mind about the "Origin of Species" and preparing for his magnanimous change of front with regard to evolution On this point Bunbury quotes (ii, 227) Sir Joseph Hooker's weighty opinion that Lyell's

"complete conversion and open avowal of his conversion to the Darwinian theory, at his time of life, and with his established celebrity, and after he had elaborately argued against the same theory in many editions of his great work, is a phenomenon almost unexampled in science"

Sir Joseph was an old friend of Sir Charles Bunbury, and botanists will read with pleasure his tribute to Hooker's genius and character (ii, 156, 226) Kingsley was another friend, and Sir Charles often records his delight in Kingsley's versatile talk and vigorous personality Kingsley must sometimes have been a little too bloodthirsty for Sir Charles Still, he quotes (ii, 266) without disapproval Kingsley's rejoicings over the victory of the Germans in the Franco-Prussian war, in which he wishes that Bunsen had been alive to see "the battle of Armageddon . fought, not as he feared, on German but on French soil"

In 1855 he paid a visit to Germany and made friends with many distinguished men Here he saw Ehrenberg, Encke, Lepsius, Jacob Grimm, "with his fine poetical head," and Ranke with his "expression of shrewdness almost of cunning rather than power" He gives (ii, 68) some account of his meetings with Humboldt, of whom he writes —

"He is a delightful old man with all the courtesy and polish of an old Frenchman, and with a vivacity and activity of mind that are perfectly wonderful in a man of eighty five He is a little bent, but still hale and fresh looking He has all the volubility of speech that I have so often heard of, but you may well suppose I was right willing to listen and did not wish to say much What is particularly striking is his eager interest in all that is going on in all the world of science, his acquaintance with all the newest researches, and his constant desire for fresh information"

Sir Charles Bunbury's letters, and especially his diaries, are of permanent interest as giving contemporary feeling about celebrated books and discoveries Thus a number of letters tell of the impression produced by the "Origin of Species" There is a curious passage (ii, 217) where he quotes with approval Lyell's surprise in 1867 at Darwin's avoidance of "any reference to a Designer" It would seem that neither he nor Lyell quite understood the Darwinian point of view

Among the numerous points interesting to botanists may be mentioned Lady Lyell's account (ii, 130) of

a visit to Robert Brown just before his death. "He talked quite calmly and cheerfully, recalling the days when he had sat in the same room in company with Banks, Solander and Dryander, and telling her *where* each of them used habitually to sit." There is, too, a striking letter (ii., 53), written apparently before Hofmeister's discoveries had reached him, in which Sir Charles argues for the connection of the Exogens with the Cryptogams by means of the Conifers, and (ii., 56) for the common nature of spores and pollen-grains.

In 1866 he noted down (ii., 214) the influences which he believed to have guided his development. Four books are mentioned:—(1) Plutarch's "Lives,"[1] which he valued as teaching magnanimity, (2) Hallam's "Constitutional History", (3) Lyell's "Principles", (4) Lindley's "Natural System of Botany." The two men of whose influence he speaks are Sir William Napier, "a great genius and a noble though singular character," and Sir George Napier, with whom he stayed at the Cape, "one of the most interesting and most profitable years of my life."

He died in 1886, aged seventy-seven; few men can have lived a long life more kindly and wisely.

F. D.

HAILEYBURY NATURAL HISTORY LECTURES.

Life and Evolution. By F. W. Headley. Pp. xvi+277; illustrated. (London: Duckworth and Co., 1906.) Price 8s. net.

THIS well-illustrated and attractive volume, according to the preface, is the final form assumed by a series of lectures delivered before the members of the Haileybury Natural Science Society, the great majority of whom are scholars at the famous Hertfordshire school. From the very nature of the case it aims, therefore, at being intelligible to readers unprovided with a large store of scientific knowledge of their own. It will be equally self-evident that it does not lay claim to be a new gospel. Rather is it an attempt, if we rightly understand its purport, to place before that section of the public which possesses a thirst for scientific knowledge a clear idea of the general structure and mutual relationships of the leading groups of animals and their adaptations to various modes of life, to show in what respects animals resemble and differ from plants, and how to distinguish between these two great primary groups of organisms, and, finally, to attempt a solution of the riddle of the evolution of organic life and of the human intellect.

The task is, of course, a heavy one, and one bristling with difficulties, but if we take into consideration the class to whom he is specially appealing and the amount of space available, we consider that Mr. Headley has come well out of the ordeal. It is not to be supposed that all his opinions will be accepted by each one of his readers, but in most cases, at any rate, he has expressed himself on debatable points with fairness and moderation, and he does not assume the character of an *ex parte* advocate. The great test of a work of this nature is whether it suits the taste of the class of readers for whom it is intended, and in the few instances in which we have been able to put this test to the proof the verdict is favourable. The style and mode of expression are almost everywhere good and interesting, and in all cases free from unnecessary technicalities, while the prevailing tone is that of a thoughtful lover of nature in all its forms. The illustrations speak for themselves.

Passing over the first chapter, which is devoted to the relationships and dissimilarities of plants and animals, attention may be directed to certain speculations in the second chapter—on the sea and its inhabitants—with respect to sedentary animals, which are regarded as having reverted to a semi-plant-like mode of existence. It is pointed out that such sedentary animals are much more numerous in the shore-waters than elsewhere. This the author believes is due to the movements of tides and currents, which bring ample food supplies without the need of any active exertion on the part of the recipients. How comes it, then, that almost all classes of sedentary animals are also well represented in the ocean-abysses, where no such free distribution of supplies takes place? The answer to the puzzle is, in the author's opinion, to be found in the fact that many of the abyssal organisms are stalked, and that they obtain nutriment by possessing the power of bending these stalks, and thus being endowed to a certain limited degree with motion. The proof that this power exists has, however, in many cases yet to be demonstrated. With regard to polyzoans and corals, the suggestion is that they may be fed by a rain of organic débris descending from the surface-waters.

Gills and lungs form the subject of the third chapter, in which reference is made to the occurrence in that hobgoblin-like fish, the Malay Periophthalmus, of an accessory breathing organ in the tail, by the aid of which the creature is enabled to spend much of its time out of water. The various phases of the respiratory function are shown to form an excellent instance of evolution, diffused breathing by the whole surface of the body giving place first of all to localised respiration by means of gills, and these again yielding to lung-breathing in the more active terrestrial forms, some of which have reverted, however, to the water, the ancestral home of all animal life.

Reptiles and their kin and the evolution of the reptile into the bird are discussed at length in the next two chapters. In seeking to find an explanation for the tendency to union between bones originally distinct, which forms such a marked feature of the avian skeleton, Mr. Headley suggests that the fusion of the tarsus with the long bones of the lower part of the legs has taken place in order to strengthen the automatic, pulley-like action of tendons which enables a bird to remain securely perched while asleep. The suggestion seems well founded. Later on we are told how the peculiar, saddle-like articulations of the cervical vertebræ enable birds to bend their necks in

[1] Fortunately for himself he read it in Langhorne's translation, so that he could peruse and re-peruse it so as almost to know it by heart. A boy of thirteen would never have got the essential good of the book if he had known it only in the original.

that supple manner which attains its maximum development in the darter, or "snake-bird" Having so carefully described this feature, it is a little surprising that the author has permitted his artist to reproduce in the plate facing p 80 the old conventional restoration of a plesiosaur with its neck bent into a swan-like curve, when, from the form of the articular surfaces of the vertebræ, it is manifestly impossible that such a flexure could have been assumed The power of neck-flexure is evidently a specialised feature due to a long process of osteological evolution

A statement on p 252 is another thing which the author on reflection would probably like to amend It is there stated that the chamæleon keeps its tongue "rolled up (the only way of pushing its monstrous length in his mouth)" This is scarcely in accord with Dr Gadow's explanation of the mechanism "The elastic part of the tongue," writes that authority, "is, so to speak, telescoped over the style-shaped copula, and the whole apparatus is kept in a contracted state like a spring in a tube"

Exception may likewise be taken to certain statements in connection with the fossil vertebrates of Patagonia on p 222 For instance, the author definitely states that the "strange hoofed animals have their nearest allies in the hyrax," whereas it is only a suggestion that one group of these ungulates might have affinity with the hyraxes, and this is discredited by Dr Andrews Again, although it may be permissible to allude to the megatherium as the megalothere, it is certainly wrong to style it the "megalothera", while to write that the seriema (not siriema) had a skull as large as that of a horse displays great want of knowledge

The author has much of interest to say with regard to the nature of feathers and the flight of birds which is one of his favourite subjects while in the final three chapters he takes into consideration the minds of men and animals, the struggle for existence, and natural selection, including under the latter heading the evolutionary theories of Darwin, de Vries, Mendel, and others To review these chapters, interesting as they are, is, however, unfortunately impossible within our allotted space We must accordingly bring this notice to a somewhat abrupt close by reiterating our opinion that the author has succeeded in producing a very readable and thoughtful book, which deserves a large *clientèle* of readers

R L

MEDICAL INSPECTION OF SCHOOL CHILDREN

The Health of the School Child By Dr W Leslie Mackenzie Pp vi+120 (London Methuen and Co, n.d) Price 2s 6d

"IN the Education Bill now [last October] before Parliament, a clause has been inserted to make medical inspection obligatory in all English State-aided schools" (p vi) "In their Scottish Education Bill of last year (1904) the Government included provision for the medical examination and supervision of school-children The examination of school-children is, therefore, no longer a question of doubtful politics. It has now all but passed into the region of administration" (p 53)

This stage having at length been reached in our own country, we can follow Dr Mackenzie with all the more readiness and interest to Wiesbaden, and listen to his account of the medical inspection of schools as he found it carried on there In this town, he tells us, there are some 10,000 elementary school-children who are under the supervision of seven specially appointed school doctors, each receiving an average stipend of about 40*l* per annum The school doctor has to examine every child when it enters and leaves the school, and during its third, fifth, and eighth school years He rejects those who are unfit for school attendance, he notifies defects to the parents, and he may give them advice as to treatment He visits the school for about an hour every fortnight in order to deal with current cases of ill-health

Dr Mackenzie describes how, on the occasion of one of his visits, he found the doctor examining thirty-five newly-entered children, observing the state of their nose, eyes, skin, bones, joints, spine, heart, lungs and the presence or absence of hernia, measuring the chest testing their speech, eyesight and hearing, and recording these various conditions on specially scheduled cards The doctor "seemed to be readily welcomed by the teachers, and was sometimes waited for by the parents, who wished to get his personal opinion of the children" (p 10)—an appreciation arguing diligent obedience to the two following regulations, which are issued in all Teutonic gravity to the school doctors "In the filling in of the particular form (notifying ill-health to the parent) all harshness and rudeness of expression are to be avoided" (p 94) "In reference to the teaching the doctor is warned that he should tactfully avoid all exposure of a teacher before his class" (p 93)

But the current of our admiration slackens when Dr Mackenzie tells us that the inspection of the thirty-five new children in the above manner occupied only an hour and a half It is difficult to believe that an examination of so wide a scope thus rapidly conducted can be of great value Practice, of course, brings speed, but not even the greatest expert could satisfactorily make such a detailed study of school children, giving an average of less than three minutes to each individual Eyesight and hearing alone could hardly be tested in that interval

"When one reflects that from twenty to thirty per cent of our school-children in Scotland suffer from eye defects needing correction or attention" (p 81), we may reasonably doubt the policy of introducing into the United Kingdom this German system of school inspection without modification

The German system should surely be modified in the direction of lightening the doctor's burden Inasmuch as "Dr Kerr, of the London County Council, found that with a little care the teachers were able to find out almost all the children that suffered from eye defects" (p 82), there is no reason why teachers should not be trained and required to test periodically

the vision and hearing of every child under their care It is manifest that "the more the teacher knows about the health of the children entrusted to him, the simpler and easier will the work of medical inspection become" (p 61) We therefore suggest cooperation between the teacher and doctor in the manner indicated

The above quotations and remarks will amply serve to show the general interest of Dr Mackenzie's little volume It is true that three of the four chapters, entitled "The Hygiene of School Life" "Normal Growth in the School Ages," "Medical Examination and Supervision of Schools and School Children," contain much that has been written of, if perhaps less attractively, before But the remaining chapter, "The School Doctor in Germany," and the appendices on "Re-vaccination of School Children in Germany" and on "The Plan of a German Elementary School," traverse comparatively unfamiliar ground, and well deserve the attention of the serious student

C S M

ELEMENTARY PHYSICS

(1) *Exercises in Physics for the Use of Schools* By J H Leonard and W H Salmon Pp vii+116 (London J Murray, 1906) Price 1s

(2) *Introductory Practical Physics* By W F Barrett and W Brown New edition Part 1 Pp xii+284 (London Simpkin, Marshall and Co, Ltd, Dublin Sealy, Bryers and Walker)

(3) *Heat, Light, and Sound an Introductory Course of Practical Exercises* By J R Ashworth Pp xv+120 (London Whittaker and Co, 1906) Price 2s net

(4) *Light for Intermediate Students* By F E Rees Pp viii+166 (London J M Dent and Co, 1906)

(5) *The Tutorial Physics* Vol iii *A Text-book of Light* By Dr R Wallace Stewart Fourth edition Revised by J Satterley Pp viii+346 (Cambridge University Tutorial Press, Ltd, 1906) Price 4s 6d

(6) *The Elements of Physics* By S E Coleman Pp vii+439 (Boston D C Heath and Co, 1906) Price 3s 6d

(7) *Physics—Theoretical and Descriptive* By H C Cheston, J S Gibson, and C E Timmerman Pp xvi+373 (Boston D C Heath and Co, 1906) Price 3s 6d

(8) *A First-year Course of Practical Magnetism and Electricity* By Dr P E Shaw Pp vii+66 (London *Electrician* Printing and Publishing Co, Ltd, n d) Price 2s 6d net

(1) A GRADUATED collection of simple arithmetical exercises in physics, including mensuration, mechanics and hydrostatics, which will prove useful for school classes No examples are given on heat conductivity Answers are furnished

(2) This text-book will be found useful for both elementary and advanced students. The volume deals with general physics, and the experiments described cover a wide range They include measurements of length, area, volume, time, and mass, experiments on fluid pressure, measurement of force, mechanical properties of solids and liquids; molecular properties of fluids The method of carrying out each experiment is briefly described, and an example is worked out in illustration Theoretical considerations are generally avoided, but many references are given to text-books or original sources, so that a student may obtain further information if he desires With such a wide range of subjects in so small a book, the treatment is often scant in places, *e g* the planimeter is dismissed without any mention of the datum circle On p 147 it is not at all clear how the mean value of Poisson's ratio is obtained from the recorded data. In the experimental proof of Boyle's law, one is told first to adjust the mercury to the same level in each limb of the tube; this very tedious operation is hardly necessary There is little meaning in the statement on p 123 that the value of g determined by simple pendulum experiments is 0 12 per cent. greater than the true value

(3) Dr Ashworth's book comprises a course of laboratory experiments in heat, light, and sound for first-year students The plan adopted with each exercise is to give a list of the apparatus necessary a short description of the method of carrying out the experiment, and a typical example to show how results are to be recorded in the note-book It is to be regretted that these examples are not always well chosen In the experiments on calorimetry, the temperature changes produced are often too small for measurement with any degree of accuracy by elementary students There is little to be gained by comparing 78·9, the determined value of the latent heat of water, with an accepted value of 79 3 when the temperature change in the calorimeter is 5° 5 C The example on the determination of the refractive index of glass, by tracing the ray through a slab, is bad Measured lengths of perpendiculars from the incident and refracted rays on the normal vary from 0·5 cm to 1 0 cm, and the mean value of the refractive index is stated as 1 52 A further illustration is afforded in an experiment to investigate the relation between the time of vibration of a spring of constant length with varying load Recorded periods are 0·54 and 0 64 second, their ratio 1 185 The ratio of the square roots of the corresponding masses is given as 1 183, and the error is stated as 0 2 per cent

(4) This little book is intended by the author for students with some previous knowledge of experimental optics The subject-matter covered, however, is very elementary, and the treatment is rather formal and meagre Two chapters, devoted to intrinsic brightness and photometry, are very clear, and will serve as a useful introduction to more advanced works on photometry Two excellent photographs of models taken with a pin-hole camera are furnished by Mr Andrew Stephenson, and a graphical proof of the minimum deviation position is due to him Lens and mirror formulæ are derived in the ordinary way The curvature method for obtaining these formulæ is not introduced, and no mention is made of the term "power of a lens" The book is attractive in appearance, and many students will probably find it useful for revision purposes

(5) The revised and enlarged edition of Stewart's "Light" contains a very full treatment of the elements of geometrical optics The inclusion of a large number of simple practical experiments enhances the value of the volume considerably Dispersion and spectrum analysis receive a fuller treatment than in the previous edition The book will prove distinctly useful.

(6) An introductory text-book of theoretical physics, the subject-matter having been selected with reference primarily to its value as part of a general education Problems are interspersed at frequent intervals, and some of these are well designed to make a student think A great deal of care has been exercised in the compilation of this book

(7) This text-book of physics, which includes mechanics, heat, light and sound, electricity and magnetism, has been written for pupils in the American high schools. The statements are concise, and the diagrams clear It is thoroughly up to date, and will prove a very suitable introductory course, especially if, as the author intends, laboratory work is carried out at the same time

(8) The author in his preface intends this book for that class of technical students who are ignorant of the rudiments of algebra, geometry, trigonometry, and mechanics The book includes three introductory exercises, six exercises on magnetism, and twenty-six on current electricity and its applications There is very little in the method of treatment to distinguish it from other elementary text-books of practical electricity and magnetism It is doubtful whether a student will draw a correct idea as to what determines a spark in air from the statement on p 30 —

"Join 1 ft. of copper wire to one terminal (of a Leclanche cell) and brush the other terminal with the free end of the wire No spark is seen because the E M F of the cell is only about 1 3 volts and the resistance is high, so the maximum current is very small"

And on p 32 (repetition with storage cell) —

"The E M F is about 2 volts, and the resistance is very small, so the maximum current is large Sparking is abundantly shown"

No thoughtful teacher would instruct a student to count the number of vibrations a magnet makes in a given time, as in the experiment described on p 13 Elementary electrostatic experiments are omitted, as these are thought to be relatively unimportant and difficult. There is little to recommend this book when compared with some excellent introductions which have appeared in recent years

OUR BOOK SHELF

Animal Artisans and other Studies of Birds and Beasts. By C J Cornish Pp xxxiv+274, illustrated. (London Longmans, Green and Co, 1907) Price 6s 6d net.

THE late Mr. Cornish was a constant contributor of articles bearing upon natural history matters to the columns of the *Spectator* and *Country Life*; and the present volume, which is edited by his widow, consists mainly of a reprint of articles from those journals, with such modifications as the course of time has rendered necessary or advisable In some cases the articles had been revised with a view to publication in book form by Mr. Cornish himself, but where this had not been done in the author's lifetime the task devolved upon the editor.

The volume opens with a brief account of the life of Mr Cornish, which will no doubt be welcome to the numerous readers who find entertainment or instruction in his works Following this are several articles, upon which the title of the volume is evidently based, some of these dealing with the works of such birds as the South American oven-bird and our own woodpeckers, while "road-making animals" and "landscape-gardeners" form the subjects of others Several of these articles display a lamentable want of knowledge of scientific zoology on the part of the author We are told, for instance, on p. 34, that "the musk-ox, the *ovibos*, is as much akin to the sheep as to *bovidae*, and in habits more like what we imagine the undescended great wild original of our sheep was than are the wild sheep of to-day" In regard to the first half of the sentence, it is now accepted that the musk-ox is not a near relative of either sheep or oxen, while the whole group is included in the Bovidæ. As to the meaning of the second half of the sentence, we are altogether in the dark Again, on p 48 we notice the astounding information that the pampas stag is the only large ruminant on the plains of South America, which, by the way, are stated to be formed of clay Other similar cases might be cited, but in the case of a posthumous work criticism must not be too trenchant, and, after all, the volume is perhaps sufficiently accurate to suit the requirements of the readers to whom it is likely to appeal

Rubber in the East Being the Official Account of the Ceylon Rubber Exhibition held in the Royal Botanic Gardens, Peradeniya, in September, 1906 Edited by Dr J C Willis, M Kelway Bamber, and E B Denham Pp 269, illustrated (Colombo H C Cottle, Government Printer)

THIS interesting and up-to-date work is the official account of the Ceylon Rubber Exhibition held in the Royal Botanic Gardens, Peradeniya, in September, 1906 (see NATURE, December 27, 1906, p 209) The duration of the exhibition allowed of its being a Rubber Congress, lectures being given upon the various branches of the subject from cultivation to vulcanisation These lectures, discussions, judges' reports, &c, have been brought together in the present volume and arranged in a logical order with the hope of making this account a standard treatise upon the rubber industry as it at present exists

The chapters dealing with the cultivation of rubber in Ceylon and other countries, treatment of diseases, tapping knives, machinery for the treatment of latex, and the shipment and marketing of rubber, should prove valuable aids to the practical rubber grower

Some idea of the rapid growth of the industry is gathered when we see that five years ago there were only 2500 acres under rubber in Ceylon, and to-day 104,000 acres, the *Hevea brasiliensis* being the species most extensively planted This tree produces the well-known Para rubber, which, prepared in the ordinary way, possesses 90 to 95 per cent of caoutchouc The Hevea appears to stand tapping operations even when of a very drastic nature

High tapping has been tried on some plantations up to 30ft and 50ft, and this system gives in some cases 12lb to 14lb of rubber per tree, but there is

a curious phenomenon in connection with this high tapping, viz., the frequent difficulty of coagulating the latex.

One lecturer, Mr. J. B. Carruthers, deals with the possibility of rubber for pavements for roadways, and mentions the rubber pavement under the archway leading to Euston Station, which was laid down in 1881. In 1902 the pavement was found to have worn down to ⅜ of an inch in the thinnest places. This rubber pavement cost less than three times as much as wood or asphalt, but the life of wood or asphalt was four years, and the life of a rubber pavement twenty years. The book is well illustrated throughout, and there are some interesting maps of Ceylon, Perak, &c., showing lands under rubber or alienated for rubber. L. C. B.

Some Modern Conditions and Recent Developments in Iron and Steel Production in America. By Frank Popplewell. Pp. x+119. (Manchester University Press, 1906.)

THIS report contains an account of a visit to the iron and steel-producing centres in the United States from September, 1903, until April, 1904, made by the author as Gartside scholar of the University of Manchester. It comprises an introductory sketch of the metallurgy of iron and steel, some general considerations on the extent of the American industry, and descriptions of the raw materials used, of the production of pig iron, and of the manufacture of steel and of rolled steel products, and, lastly, some notes on American labour and education.

The author employed his time well, and has given a clear idea of modern conditions. The important subjects of the Steel Trust, organised labour, and railway transport are not touched upon, and the report suffers from the disadvantage that progress is so rapid in America that in the interval that has elapsed between the visit and the publication of the report many important changes have been effected which have rendered some of the information collected antiquated, and much of the interest has been impaired by the publication of reports by later visitors, notably in the German work by Dr. H. Levy, and in papers written by members of the Iron and Steel Institute who took part in the New York meeting of that society. Thus there is no mention of the most interesting novelty in blast-furnace practice, namely, Mr. Gayley's desiccation of the blast by a preliminary chilling of the air before its admission to the cylinder of the blowing engine, nor does the index refer to the Talbot continuous steel-making process which, first used at Pencoyd, has proved surprisingly economical in this country. Mr. Popplewell gives, however, a clear exposition of the results of specialisation in production, of the development of ore-handling machinery, and of the general use of the charging machine, features that characterise American practice. He shows, too, that the colossal blast furnace with huge yield due to high-blast pressure, regardless of consumption of steam and boiler coal, is giving place to a blast furnace of more modest dimensions, with a maximum height of 80 feet or 85 feet, for the treatment of fine ores.

The impression derived from reading Mr. Popplewell's report is that many of the most striking developments, admirable as they are, were designed to meet special wants, and are not necessarily applicable in Great Britain. Thus, to give one example, the enormous stock piles called for by the intermittent navigation of Lake Superior are not required in districts where supplies arrive continuously throughout the year.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Positive Charge Carried by the α Particle.

IN a letter in NATURE (August 2, 1906) I gave an account of some experiments which I considered proved that the α particle as initially expelled is not charged, and I also gave an account of the same work in a paper read before the British Association at York last August. Although I have no reason to doubt the accuracy of the experiments published in my letter, I do not now consider them sufficiently conclusive, as some recently published researches on the α particle have to be taken into account in their interpretation. I refer chiefly to a paper published by Rutherford shortly after my letter (*Phil. Mag.*, October, 1906, p. 348), in which the view is put forward that the α particle carries two atomic charges.

Now the reasoning in my letter was based on the assumption, then held universally, that the charge on the α particle was the indivisible single atomic charge, and it was not necessary at that time to contemplate the possibility of any intermediate condition existing between the α particle charged and uncharged. But it is clear that if, as Rutherford considers probable, the α particle carries a multiple charge, the results I published in my letter do not by themselves suffice to prove that the α particle as initially expelled is uncharged, for it might possess a fraction of its final charge initially, obtaining the remainder and becoming correspondingly easier to deviate magnetically in its passage through matter. This is, of course, a contingency not contemplated in my original conclusion.

I had hoped long ere this to submit this point to an experimental test, which is simple enough to do by varying the strength of the field. But I very much regret I have no longer the essential facilities necessary to carry on the investigation, particularly the means of obtaining a steady supply of liquid-air, and there does not appear to be any immediate prospect of my being in a position to repeat the experiments. The question at issue is a somewhat fundamental one in the relations of electricity and matter, and of course, cannot be finally settled by any one series of experiments, but only after long-continued and frequently verified observations. But I can neither continue the investigation nor even repeat the experiments I have already made, so nothing remains but to withdraw what I have already published. FREDERICK SODDY.

The University, Glasgow, February 26.

The Rusting of Iron.

IN NATURE of February 21 (p. 390) appears a letter from Prof. Wyndham R. Dunstan in which he represents me as having concluded "that carbonic acid is essential to the rusting of iron, and that rusting does not occur in its absence." As such a general statement, without reference to the context of the paper to which Prof. Dunstan refers, may prove misleading, I shall be obliged if you will allow me to point out that the main and incontrovertible conclusion drawn from experiments extending over a prolonged period is that iron does not undergo oxidation in presence of oxygen and water. If, however, a minute quantity of acid (either carbonic acid or *any other acid capable of attacking iron*) be present, the metal is first converted into ferrous salt, which subsequently oxidises to rust. Samples of iron which contain such impurities as sulphur, phosphorus, and carbides may give rise to free acids when in contact with water and oxygen, and under these conditions rusting may be expected to occur, even if carbonic acid be rigorously excluded.

Prof. Dunstan does not inform us if he adheres to his definitely expressed views "that iron, oxygen, and liquid water are alone necessary for the rusting of iron to take place," and that "hydrogen peroxide is a necessary intermediate product of the chemical change involved in rusting," but he confines himself to stating again that acid potassium chromate, a substance which destroys hydrogen

peroxide, inhibits rusting He ignores the fact that there are other substances, such as potassium iodide, which immediately destroy hydrogen peroxide and yet do not inhibit the rusting of iron Moreover, if Prof Dunstan's assumption that substances which destroy hydrogen peroxide (which he regards as an essential initial product of rusting) inhibit rusting be accepted, it will be necessary to admit, contrary to the general experience of chemists, that the presence of a substance capable of removing one of the products of an action does not accelerate the action, but actually prevents it

Prof Dunstan does not say in what respects his experiments on the oxidation of iron have afforded results differing from my own, but I may remind him that only after repeated failures was I successful in bringing together iron, oxygen, and water, and in avoiding the presence of acid

GERALD T MOODY

Central Technical College, February 22

The Valparaiso Earthquake, August 17, 1906

PROF MILNE'S note in NATURE of February 21 raises an interesting question which can readily be answered, the earthquake which preceded the Valparaiso shock originated under the North Pacific Ocean in about 30° N lat, 170° E long, at about 0h 11m a m G M T, or 35½ minutes before the Chilian earthquake as recorded at Santiago This position does not agree with the distance given in the note, but Prof Milne in correspondence, has informed me that this is in error, and the distance, as indicated by the Shide diagram, is 90°, which is in close accordance with my own determination of the distance

It must be remembered that all attempts at deducing the distance of origin from a single seismogram are necessarily approximate, though the error will probably be within 5° of arc, or about 350 miles, in the case of a great earthquake giving a complete record The determination of the place of origin becomes easy when a sufficient number of records from widely separated localities are available and these are at my disposal for seeing that the Chilian earthquake was likely to be an important one in connection with an investigation on which I was engaged I wrote to a number of seismological stations the addresses of which were known to me, and met with a most generous response to my requests Unfortunately, when the copies of seismograms came in it was evident that they recorded two earthquakes, of which the earlier was of unknown origin the record of which in every case overlapped that of the Chilian one, and rendered the latter practically useless

R D OLDHAM

Nomenclature of the Proteins

IN the current number of the Proceedings of the Chemical Society, the council has issued some valuable proposals for change in the nomenclature of the proteids and allied substances While not venturing to criticise the majority of the recommendations I notice a definition in the proposed subclass 5 which appears to me slightly inaccurate The subclass in question reads as follows —

"5 Sclero-proteins This new word takes the place of the word albuminoid in the limited sense in which the majority of physiologists have been accustomed to use it It includes such substances as gelatin and keratin, the prefix indicates the skeletal origin and often insoluble nature of its members"

Now, it seems to be a generally accepted view that gelatin does not exist ready-formed in nature but results from the hydrolysis or hydration of collagens (v Allen's "Organic Analysis" vol iv and Cohnheim's "Chemie der Eiweisskörper") Is not gelatin as much a product of protein hydrolysis as acid-albumin or alkali-albumin, for which the generic term meta-proteins is now proposed? Would it not, therefore, be preferable to reserve the term sclero-proteins, in its strictest sense, for the wholly insoluble products of animal-cell activity such as chondrigen, ossein, sericin, and keratin, and class their hydration-products such as gelatin and silk-gelatin among the meta-proteins?

The committee apparently sees no objection to including gelatose among the proteoses

W S GILLES

Bocking, Braintree Essex March 4

Maximum Gravitational Attraction on a Solid.

CAN you tell or refer me to the solution of the following question —

What will be the shape of a definite quantity of mass of given specific gravity in order to obtain maximum gravitational attraction at a point on its surface? I have tried various shapes of equal volume, including square and rectangular figures, hemisphere, sphere, and cones For these shapes I found that the maximum attraction obtained at the centre of the base of a cone the apex angle of which was about forty degrees, no doubt the frustrum of such a cone would attract with greater force

This question is no doubt of academical interest only, but the solution should be instructive from certain points of view

W E MILLER

Publication Bureau, General Electric Co, Schenectady, New York, U S A

THE solid is one of revolution (evidently), and the attraction being a maximum is unaltered by shifting a small elementary ring of matter from one point to another of its bounding surface If dM is the mass of a ring formed by the revolution of the point r, θ, then the attraction is $dM\cos\theta/r^2$ Hence the equation of the generating curve of the boundary is $\cos\theta/r^2=\text{const}$, or $r^2=k^2\cos\theta$ say or $(x^2+y^2)^3=k^4x^2$ The curve may be traced by drawing the circle $r=k\cos\theta$ and taking on each radius vector a mean proportional between that radius and k

According to this result, the form of the bounding curve for a surface of revolution is the same as it would be for a plane lamina possessing the same property The agreement can be justified by taking a thin slice through the axis of the solid The matter contained in this slice must evidently be arranged in such a form as to give the maximum attraction independently of the remaining parts of the body

G H BRYAN

A New Chemical Test for Strength in Wheat Flour

THE test described as new by Mr Wood in NATURE of February 21 has been in use in my laboratory during the past year, where it forms part of the regular routine tests applied to flour While I am fully in agreement with Mr Wood's view that the volume of carbon dioxide evolved by a mixture of yeast and flour under standard conditions is a measure of the sugar content of the flour together with other fermentable matter produced during the fermentative change, it is important not to lose sight of the influence exercised by the character of the gluten on the volume of the loaf A rotten gluten when distended by too much gas will break, and the gas will escape from the dough From this point of view the character of the gluten is clearly of fundamental importance but after all, the problem is one in which no small number of variables must be dealt with

E FRANKLAND ARMSTRONG

A Remarkable Lunar Halo, February 24.

IN NATURE of May 1, 1902 (vol lxvi, p 5), a remarkable lunar halo was described as having been witnessed from the Yerkes Observatory on January 19, 1902 It consisted of an ordinary lunar halo, of 45° or 50° in diameter, and of a second ring approximately the same in size intersecting the first, and cutting exactly through the moon

The same phenomenon was very clearly seen by myself and others at Pembroke Dock during the evening of Sunday, February 24, between 9 p m and 10 p m The secondary ring appeared to be about a third as large again in diameter as the primary, and was situated approximately to the north-east of it In both rings the brownish tinge of the edges and dark interiors were perceptible, though very much more strongly in the primary than in the secondary

I should be glad to know whether any explanation has yet been advanced as to the optical formation of the secondary ring in the above rare phenomenon

H F HUNT

7 Officers Row, Pembroke Dock, Wales February 26

A PRACTICAL HANDBOOK OF BURMA[1]

SIR GEORGE SCOTT has condensed into a volume of 485 pages, which any tourist can conveniently carry about, a mass of useful information about Burma. The book is described in the preface as of the nature of a skeleton or of a painter's study for a larger work. It is, however, much more than this, and contains all that any ordinary tourist needs to know about Burma, and, indeed, a good deal which is not known even to some who have resided for many years in Burma.

The work is divided into seven parts. Part i., "The Country and Climate," contains, besides an account of the fauna, flora, and geology and minerals of the country, a most interesting account of the races of Burma.

It is doubtful who were the original inhabitants of Burma. The only aboriginal tribe of which there is any trace are the Selungs, who live in the islands of the Mergui archipelago. Their language shows affinities with those of the Tsiam or Cham aborigines of Cambodia and of the Ætas or Negritos, aborigines of the Philippine Islands. In any case, the aboriginal inhabitants have been almost entirely replaced by swarm after swarm of Indo-Chinese invaders who have come down from north-western China, from Tibet, the Pamirs, and Mongolia, following the course of the great rivers. The Indo-Chinese were followed by the Tibeto-Burmans. After the Tibeto-Burmans came the peoples of the Siamese-Chinese sub-family—the Karens and the Tai, or Shans, and the last irruption, that of the Chingpaw, was only stopped by the British occupation of the country. The people of Burma, although they are divided into many tribes and races, are, with the exception of the Selungs, all of the same original stock. Out of the total population of Burma, which was found at the census of 1901 to be approximately ten and a half millions, about seven millions speak Burmese.

Sir George Scott gives an account of all the various races found in Burma, and illustrates his text by photographs of many of them. We here reproduce the frontispiece photograph of the stiff-necked Padaung belles. These women wear neckbands of solid brass rods. The bands vary in number from five to twenty-five, and the idea with which the bands are worn is to keep the neck always on the stretch. Five coils are all that can be got on to begin with, but fresh coils are added as space is made for them as the girl grows, so that the neck is constantly kept at the stretch until the full limit of twenty-five bands is reached. Similar coils are worn on the legs and arms, so that the average woman carries fifty or sixty pounds of brass, and some manage as much as eighty pounds. Thus weighted, they carry water for domestic use, hoe the fields, and go long distances to market.

FIG. 1.—Stiff-necked Padaung Belles. The neckbands of these women are of solid brass rod. They vary from five coils to twenty-five. From "Burma: a Handbook of Practical Information."

Part ii. contains an account of the Government of Burma. The first provinces of Burma to be annexed were Arakan and Tenasserim after the first Burmese war in 1826. The province of Pegu was added in 1852, after the second Burmese war, and Burma, as it now stands, was completed by the annexation of Upper Burma after the third Burmese war of 1885–1886.

The three provinces of Arakan, Tenasserim and Pegu were administered each by their own Commissioner under the Governor-General of India until 1862, when they were amalgamated under a Chief Commissioner, and it was not until May 1, 1897, that Burma became a Lieutenant-Governorship.

The account given of the duties of officers is generally correct, but since the handbook was written commissioners of divisions and deputy commissioners of districts in divisions and districts where work was heavy have been relieved of judicial duties by the appointment of divisional and district judges, whose time is devoted entirely to judicial work.

In this part Sir George Scott gives an excellent account of the Shan States, with which he is so intimately acquainted. The progress made in the Shan States, which were in a state of complete anarchy when Upper Burma was annexed, is surprising. All that they now require to secure their further development is the Southern Shan States railway, which will, it is anticipated, soon be commenced. Accounts are also given of Karenni, the Kachin Hills, and the Chin Hills. The Northern and Southern Shan

[1] "Burma: a Handbook of Practical Information." By Sir J. George Scott, K.C.I.E. Pp. x+520. (London: A. Moring, Ltd., 1906.) Price 10s. 6d. net.

States, Karenni, the Kachin Hills, and the Chin Hills are all administered by special officers under regulations which are suited to the primitive condition of the people

The subject of education is also dealt with in this part It is remarked that there is no province in India which can compare with Burma in the number of the population able to read and write The fact that primary education is so widely diffused is due to the indigenous schools Every monastery is a school, and there is a monastery in almost every village Education is free, and there are no caste restrictions in Burma There every Buddhist boy learns at least to read and write

Part ii concludes with a history of Burma from the earliest times The history is as complete as it is possible to make it in 38 pages An authentic photograph of the ex-King Thibaw and the ex-Queen Supaya-Lat, who are now detained at Ratnagiri, an old Portuguese fort on the west coast of India, is given at p. 200 of the handbook

FIG 2.—Wa Suspension Bridge From "Burma a Handbook of Practical Information.

Part iii deals with industries, the forests of Burma, mines, agriculture, trade, transports, currency, weights and measures. All these subjects are dealt with exhaustively, and this part will well repay perusal.

The subjects discussed in part iv are archæology, architecture, art, and music Burma is called the land of pagodas, and Sir George Scott points out that there are three distinct types of religious buildings—the solid pagoda enshrining relics, the carved and ornamented wooden monasteries, and the masonry temples The most celebrated temples are in the ruined town of Pagan Many pagodas are in ruins because, except where the founders have endowed them, and thus assured their preservation it is to nobody's interest to preserve a pagoda The merit of erecting a pagoda is great, but the merit attaches to the original builder, and not to the restorer or repairer

The Government provides for the maintenance of some of the most notable pagodas, and for others there are trustees, who administer the endowments and collect the offerings of the faithful, and spend the proceeds on the repair of the buildings, but ruined and deserted temples are to be seen all over the country

Part v is taken up with an account of the Buddhist religion which is very complete As Sir George Scott states, there is no doubt that the original religion of Burma was animism, and that this form of religion still survives amongst the vast body of the people Buddhism, as many consider, is not a religion at all, but a system of philosophy What most Burmans really reverence are the spirits of the air, the mountain and the fell Many of the hill tribes are spirit worshippers pure and simple Serpent worship too, still survives

Part vi is devoted to language and literature We are sorry that space does not permit us to give any extracts from this part

Part vii concludes the handbook with some useful hints to residents or new visitors, and the last paragraphs of this part tell the readers something about sport

There are also three appendices The illustrations are numerous and good. We reproduce as a sample the photograph of a Wa suspension bridge

In conclusion, we strongly recommend every intending visitor to Burma to provide himself with a copy of this handbook, in the compilation of which Sir George Scott has shown that he has a thorough knowledge of the country, to which he has added much industry and research

We think that the handbook, besides being indispensable to the tourist, is also well worth perusal by members of the non-travelling public who are anxious to know all that can be told about one of the most recent, and at the same time most interesting, possessions of the British Crown

PROF MARCEL BERTRAND

IT was with deep regret that English geologists learned that Prof Marcel Bertrand, professor of geology at the French National School of Mines, died on Wednesday, February 13 Born in Paris on July 2, 1847, a member of a family of great mathematicians, he inherited a natural gift for the exact sciences, and especially for geometry, which enabled him to enter into l'École Polytechnique in 1867 In 1869, owing to his brilliance as a student, he was selected by the French Government as mining engineer For three years he attended the courses of Élie de Beaumont and others at the School of

Mines This teaching decided the direction of his life's work along the traditional lines of the school of which he was in turn a student, an instructor, and one of the most distinguished professors from the year 1886

It is a special feature of the French Geological Survey to avail itself of the help of outside professional geologists, such as university professors and teachers, by engaging them during the summer holidays as auxiliary collaborateurs It is in that way that Marcel Bertrand was induced to carry out during the summer months of several years a series of field observations in the Jura mountains, with the view of publishing detailed geological maps of the region It was quite natural that the growing interest of the young geologist was excited by the structure of this district - classical for the relative regularity of its foldings

In 1881 Bertrand was led in the same way to investigate the geology of Provence, where a simple appearance hides extreme complexity of structure It was there that, after several occasional visits to the Alps, he was able to bring new light to bear on the earth's anatomy He was the first to perceive that the foldings of the pre-Alps have been altered in depth by the older horst of Maure Mountains, and have resulted in extensive overfoldings which later on have been again obliquely plaited by more recent compression These investigations culminated in 1887 in the publication of his "Memoire sur le Beausset (Var)," which, notwithstanding its shortness and local character was received with keen interest by Continental geologists It was for them the starting point for further inquiries upon new forms of disturbances, and especially upon those long recumbent folds the horizontal extension of which is so great that they are frequently spoken of as sheets

Bertrand's great experience of the coal mines of the north of France afforded him the opportunity of detecting that overthrusts of the same amplitude had taken place at the close of the Carboniferous period He expounded these similarities in his memoirs upon "Les Rapports de Structure des Alpes de Glaris et du Bassin Houiller du Nord," where it was suggested, for the first time, that the famous dopple fold of Glaris might be regarded as a single exaggerated overfold coming from the south This explanation is now accepted by Prof Heim himself

In 1896 Bertrand wrote a preface to introduce to the French public a translation of Suess's "The Face of the Earth" If anyone should deny to scientific men the gift of expressing their ideas in a concise and adequate style, reference should be made to this brilliant and lucid account of the progressive development of structural geology from the first attempts of Leopold de Buch and Élie de Beaumont to the synthesis of Suess involving the whole surface of our planet, or the minute re-construction of the former orography of the Highlands by Prof Lapworth

In 1896 Bertrand was elected a member of the Académie des Sciences to fill the chair left vacant by the death of Pasteur In 1900 he took a large part in the organisation of the Paris meeting of the International Geological Congress He contributed two papers on the geology of the Western Alps, and personally directed one of the excursions in that district It was the last gratification of his life, for shortly after he suffered great affliction by the death of his daughter, who was buried by a sand-slip when geologising with him

It is deeply to be regretted that such a gifted man has passed away without having fulfilled his possibilities. He scattered some of his original ideas in short papers which appeared from 1884 until 1900, chiefly in the *Comptes rendus* of the French Academy of Sciences, in the *Annales des Mines*, and in the Bulletin of the Geological Society of Paris. But he did not concentrate his abilities upon a great scientific work which might have been compared to the volumes by Prof Suess Our only consolation is the power he possessed to impart his spirit to his students and to the number of his disciples, such as MM de Launay, Lugeon, Termier, Caveux, Ritter, &c, whom he left behind fitted to carry on his work

M M ALLORGE

H C RUSSELL, C M G, F R S.

THE announcement of the death of Mr H C Russell, who for nearly forty years was among the foremost representatives of science in the colony of New South Wales, has been received with great regret by many men of science Since 1870 he held the post of Government astronomer and director of the Sydney Observatory, in succession to Mr G R Smalley, and in that capacity rendered most important services to the colony His first duty on appointment was to organise the resources of the colony for the observation of the transit of Venus With small funds, little skilled assistance, and short time for preparation, he nevertheless succeeded in equipping several stations in a highly efficient manner, reflecting great credit upon the readiness of the colonists and the exertions of the observatory staff

Thenceforward the observatory pursued a course marked by continually increasing usefulness, culminating in the acceptance of a share in the international photographic chart of the heavens The zone allotted to this observatory extends from $-52°$ to $-64°$ declination, and under Mr Russell's direction the task advanced far towards completion But in the course of the work it was found that considerable improvement might be effected if the telescope were removed to a station remote from the town of Sydney The director had long advocated the removal of the observatory, and the mounting of the photographic equatorial at Red Hill probably presages the abandonment of the Sydney site The measurement of the plates is being prosecuted on a common plan with those taken at Melbourne, and one of the latest papers from Mr Russell has reference to an improved form of micrometer for the measurement of these plates Mechanical devices always had great interest for the late director, and he paid great attention to special forms of driving clocks for equatorials

But most of all the colony is indebted to him for his organisation of the meteorological service. He had charge of a district of the climate of which little was known, and as the colony extended and the population occupied areas of unexplored country, he had to widen the range of his inquiry in order to supply the necessary information to intending settlers The long series of observations that he published on climate factors, especially those having reference to rain, evaporation, and state of the rivers, attest to his industry, his powers of organisation, and his recognition of the requirements of a young and rising colony He put it on record that when he assumed office there were but five rain-gauges in the colony On his retirement there were something like two thousand His discussion of the results has scarcely been as happy as his collection He seems to have relied upon statistical methods rather than on physical facts, and in this way was led to suggest a theory which would make the

amount of precipitation depend upon the moon's nodes These cycles are shown very distinctly over the few years that he was able to bring under discussion, but his explanation has not been generally accepted This is a small matter in comparison with the value of the information which he was able to furnish, and which has contributed in no small degree to the prosperity of the colony. This collection of observations will be of the greatest service in subsequent inquiries

Mr Russell has left a character for industry and closeness of application that cannot but prove stimulating to future astronomers in the southern hemisphere. He was much esteemed by many friends in this country, who regretted his retirement from the observatory, and besides being a Fellow of the Royal Society, to which he was elected in 1886, he was a member of many learned bodies, and was well known as a contributor of frequent and welcome papers

W F P

DR ALLAN MACFADYEN

BACTERIOLOGICAL science in England has sustained a great loss by the early death of Dr Allan Macfadyen, who passed away on March 1 a martyr to that science he loved so well and to which he had devoted his best days, his last illness being caused by accidental infection in the laboratory

Dr Macfadyen was a distinguished graduate of Edinburgh University, and subsequently studied at Bern, Göttingen, and Munich One of his earliest investigations was on the behaviour of the bacteria in the digestive tract, in which he proved that the gastric juice and intestinal secretions protect but little against the invasion of pathogenic microbes This was soon followed by a joint paper with Prof Nencki and Dr Sieber, on the chemical processes occurring in the small intestine of man in which the intestinal contents were examined and the exact chemical changes produced by several intestinal microorganisms in pure cultures were studied With Sir Lauder Brunton, an investigation of the ferment action of bacteria was contributed to the Proceedings of the Royal Society, and his chemical bent was further shown by a paper on the action of bacteria on albumins and peptones, which appeared in the Reports of the Local Government Board The thermophilic bacteria, organisms which thrive at high temperatures, attracted his attention, and with Dr Blaxall he carried out an investigation on them in which, almost for the first time, a number of species were differentiated and their action studied With Dr Harden, Mr Rowland, and the late Dr Morris, researches were conducted on the nature of the yeast zymase of Buchner, and the phosphorescent bacteria and problems of disinfection were other subjects in which he made additions to our knowledge

Dr. Macfadyen was early inspired with the idea of the paramount importance of the contents and extracts of the unit of life—the cell—and the happy culmination of Sir James Dewar's researches on low temperatures gave him an unlooked-for means of obtaining these in a comparatively unaltered state He showed that the low temperatures of liquid air and of liquid hydrogen had little or no effect on either the vitality or the functions of microorganisms With Mr Rowland he attacked the problem of grinding up bacteria with liquid air, and by a number of ingenious devices he finally succeeded in obtaining the juices of bacteria in sufficient quantity for investigating their characters The comparative failure of attempts to produce therapeutic sera for such diseases as tuberculosis, typhoid fever, cholera, pneumonia, &c, the organisms of which produce little or no extra-cellular toxins, suggested that the juices of these organisms, the "endotoxins," obtained by liquid-air grinding, might be used for immunising He showed successively that the virulence of an organism varied directly with the amount of endotoxin that could be obtained from it, that an animal might be immunised by means of these endotoxins, and that the serum of such an animal possessed immunising and curative properties

The application of these principles to the typhoid bacillus, cholera vibrio, pneumococcus, and hog-cholera bacillus was described in a series of papers Latterly, the application of the results to the treatment of human disease occupied Dr Macfadyen's attention with encouraging prospects, and it is a tragic circumstance that he should be cut off just as his life-work seemed to be nearing completion

As secretary and head of the Bacteriological Department of the British, Jenner and Lister Institute of Preventive Medicine, as it was successively named, Dr Macfadyen had a large share in the organisation of the institute at Chelsea, and much of the bacteriological work that emanated from there was inspired by him As Fullerian professor of physiology at the Royal Institution 1901–4 his courses of lectures on the cell, antitoxins physiology of digestion, and other subjects made him known to a wide circle

R T H

NOTES

THE following candidates were selected on Thursday last by the council of the Royal Society to be recommended for election into the society —Frank Dawson Adams Hugh Kerr Anderson, William Blaxland Benham Lord Blythswood, William Henry Bragg Frederick Daniel Chattaway, Arthur William Crossley Arthur Robertson Cushny William Duddell Frederick William Gamble John Ernest Petavel Henry Cabourn Pocklington Henry Nicholas Ridley Grafton Elliot Smith and William Henry Young

PROF W A TILDEN F R S has been elected a member of the Athenæum Club under the provisions of the rule of the club which empowers the annual election by the committee of three persons "of distinguished eminence in science literature the arts, or for public services"

A DEPUTATION representing the Anthropological Institute, the British Science Guild and other scientific bodies waited upon the Prime Minister on Tuesday to urge the establishment of a national anthropometric survey Mr R C Lehmann, M P who introduced the deputation said that, in the first instance the survey should have for its object the periodic measurement of children and young people in schools and factories Besides this, a comprehensive survey of the general population of the whole country should be undertaken The sum asked for is 4000*l* or 5000*l* The need for such a survey was described by Dr D J Cunningham, Mr J Gray Dr Gow Sir Lauder Brunton and Dr A C Haddon In his reply to the deputation Sir Henry Campbell-Bannerman confessed that he has been much impressed by the arguments adduced as to the great lack that there is in this country of knowledge of the quality of the population It is obviously desirable to have a record of the kind proposed in order to be able to study the changes in the condition of the people at large as a guide to action in administration and in legislation regarding it Any test applied to the condition of the inhabitants of any district is a test of their surroundings, of the mode in which they live.

and the circumstances which affect their health and utility and therefore this cannot be an unimportant thing It is very desirable to avoid any impression that a sort of experiment is to be practised upon the poor children in the common schools Whatever is done to the poor ought to be done also to the rich, and the application of the system ought to be universal In fact, it will cease to have its proper value if it is confined to the poor schools, which are a little more at the disposal of the Government and the authorities than the great schools, such as Westminster and others. Results are wanted referring to the whole population, so that comparison may be made between different districts and different occupations The sum mentioned for the survey is a modest amount, but a great many modest sums make up a large sum But the mere question of cost is not likely to stand in the way of a great scheme of this sort if the Government is satisfied on full consideration—which shall be given to it—that the time is ripe for this new enterprise

THE Goldsmiths' Company has contributed the sum of 1000*l* to the research fund of the Chemical Society

THE 134th anniversary dinner of the Medical Society of London will be held on Wednesday, March 13, at the Whitehall Rooms, Hotel Metropole

THE death is announced of Mr C A Witchell, author of "The Evolution of Bird Song, with Observations on the Influence of Heredity and Influence," and of other works on natural history

A MEETING of the Institution of Naval Architects will be held on March 20–22 At the opening meeting Lord Glasgow, president, will deliver the presidential address, and the gold medal of the institution will be presented to Prof R L Weighton

THE *British Medical Journal* states that the Portuguese Minister of Marine has decided to send a scientific mission to the Ilha do Principe, in the Gulf of Guinea, for the purpose of trying the effect of measures of general prophylaxis against sleeping sickness, the prevalence of which on the island continues to increase

ON Thursday next, March 14, Dr C W Saleeby will begin a course of two lectures at the Royal Institution on "Biology and Progress" The Friday evening discourse on March 15 will be delivered by Prof Lunge, on "Problems of Applied Chemistry," and on March 22 by Prof J J Thomson, on "Rays of Positive Electricity"

AT the meeting of the Anthropological Institute to be held on March 12 in the theatre of the Civil Service Commission, Burlington Gardens, W, Dr C G Seligmann will exhibit a series of kinematograph pictures illustrating New Guinea native dances Persons desirous of being present can obtain cards of admission on application to the secretary of the Anthropological Institute, 3 Hanover Square, W

IN reply to a question asked in the House of Commons on Monday as to the cause of the recent explosion in the research laboratory at Woolwich, Mr Haldane said —"It is doubtful whether cordite can be detonated, but if it is possible the circumstances must be exceptional Dynamite, if lighted, cannot be detonated unless it is confined. There was no iodide of nitrogen in the research laboratory in the chemical research magazine It can be detonated under water, and cannot be kept in a dry state An inquiry is being held as to the cause of the explosion at Woolwich"

IN January the American Museum of Natural History sent over a party, under Prof H F Osborn, to the Fayûm desert of northern Egypt to explore and collect fossil vertebrates in the Upper Eocene formations made famous by the discoveries of Beadnell and Andrews. Captain H G Lyons, director-general of the Egyptian Survey Department, rendered material assistance in outfitting the expedition, and detailed Mr. H. I. Ferrar, of the survey, for a three weeks' tour of the formations with Prof Osborn As a result of this tour, it was decided to confine the search principally to the Upper Eocene. The party reached the Fayûm on February 5, and at once began the work of prospecting and excavating, which will be continued for two or three months under the direction of Messrs Granger and Olsen, of the American Museum The chief objects of the party are first to secure a representative collection of the extinct animals already known, second, to extend our knowledge of the small fauna of the period The first step in the latter direction has been the discovery of Rodentia apparently of the myomorph group

MR W BURDETT-COUTTS has decided to arrange for the publication in due course of a life of the late Baroness Burdett-Coutts He informs us that he is anxious that those persons who possess letters of interest from the Baroness, addressed to them or their forbears, should send correspondence (after May 1 next) to him at 1 Stratton Street, London, W, or communicate with him on the subject All documents will be treated with great care, and returned as soon as practicable, intact to their owners after the necessary extracts have been made from them At a general monthly meeting of the members of the Royal Institution on Monday, March 4, a letter from Mr Burdett-Coutts was read expressing appreciation of the terms of a resolution, with reference to the death of the Baroness Burdett-Coutts, sent to him by the Royal Institution In the course of his letter, Mr Burdett-Coutts says —The Baroness's social relationships to science, her friendships with many, her acquaintance with nearly all, of its eminent professors for the past seventy years, are well known, her efforts to encourage and aid those who were struggling in the same path, not so well as was her custom If a scholarship was to be established at Oxford, not classics or history, or even theology, but science claimed her aid Such things were not done at haphazard She would spare no trouble to search out both the need and the means With a touch of characteristic humour she inquired of Sir Wm Hooker whether Kew Gardens, so far up the Thames, was not poor in seaweeds She had already found out the fact, and had secured the Griffiths collection, so rare and extensive that, without impairing the central completeness, it provided duplicates for six other botanical establishments She probably had not read Schimper's monograph on the genus Sphagnum, and did not know the details of the muscological collection of Bruch; but she found out that Kew also wanted mosses, and that Schimper's great herbarium could be acquired. Thus, not so much by wealth as by thoughtful insight, special departments of British science were enriched at her hands.

AT the annual general meeting of the Geological Society on February 22, Sir Archibald Geikie, the president, described the arrangements contemplated for the celebration of the society's centenary next September Invitations to attend the meetings will be sent to all the foreign members and foreign correspondents of the society, and geological societies, geological surveys, and learned institutions which

have a geological side, will be asked to send delegates Personal invitations will also be addressed to geologists of note in the old and the new world, who are not already enrolled in the foreign lists of the society The official programme will probably extend over three days in London. The arrangements for each of these three days are under consideration, but Sir Archibald Geikie proposes to give his presidential address as the *pièce de résistance* of one of the forenoon or afternoon meetings In that address he will offer a sketch of the state of geological science outside Britain at the time when the Geological Society of London was founded and indicate the external influences that affected its start. By this choice of a subject he hopes to interest the foreign guests, while at the same time inviting the fellows of the society into a domain of the history of science which is perhaps less familiar than it deserves to be The chronicle of the society itself during the first hundred years of its existence has been carefully and fully compiled from all available sources by Mr Horace B Woodward for publication in volume form Excursions to places of geological note in this country will probably be arranged, some to precede and others to follow the meeting in London The various museums and places of interest in the metropolis will, of course, be shown to the expected visitors, and there will doubtless be no lack of public and private hospitality It is anticipated that the Universities of Oxford and Cambridge will both receive the foreign guests

To *Naturen* for January Prof A W Brogger contributes an illustrated account of the oldest stone implements of Norway These are all Palæolithic, and include "celts," together with two distinct types of "axe-heads"

A PAPER by Mr E D Congdon on the hydroid polyps of Bermuda is published in the January number of the *Proceedings of the American Academy of Arts and Sciences*, and two on plankton crustaceans from the San Diego region, by Mr C Juday, are issued in vol iii (parts ix and x) of the zoological series of the University of California Publications

IN an earlier number of NATURE reference was made to an exhibition in the hall of the Natural History Museum of specimens sent by the Marine Biological Association at Plymouth This exhibit has been augmented by a jar of specimens illustrating the transition from the marine leptocephalus larva into the fresh-water elver, or young eel, and by a second vessel containing specimens of the various animals which go to form the ordinary diet of the cod Thirteen species are included in the latter, among which four are (for the most part immature) fishes

THE January number of the *Victorian Naturalist* contains an account of a traverse of the Owen Stanley Range, British New Guinea by Mr C C Simpson Some interesting observations on the habits of birds-of-paradise, of which several species were seen, are recorded The "six-plumed" and "magnificent" species have dancing grounds, carefully cleared on which they disport themselves, while the "raggiana" has a special tree to which the males resort for their nuptial display but the other species use for this purpose any tree that may be convenient. In the author's opinion, many of the rarer species lay only a single egg

THE Paris illustrated magazine *Madame et Monsieur* for February 17 contains an appreciative account of Prince Roland Bonaparte and his scientific researches The Prince is, indeed, before all things a *savant*, and devotes the whole of his available time to scientific investigation Although botany claims the first share of his attention, he likewise devotes much time and money to anthropology having brought together a unique collection of anthropological photographs, while geology is by no means neglected Prince Roland is likewise a great traveller, having visited a large part of the North American continent The herbarium in his palace in the Avenue d'Iéna *is stated to contain not less than 700,000 species of plants* The Prince has just been elected a member of the French Academy of Sciences

WE have been favoured with a copy of the first part of a new work, "The Kennel Encyclopædia," edited by Mr J. Sidney Turner, and published by the Encyclopædic Press, Sheffield The work, it is estimated, will run to about sixteen parts, to be issued at intervals of from four to six weeks Judging from the illustrations to the article on Airedale terriers the work promises to be of an exceptionally attractive nature Mr R I Pocock contributes an excellent article on the ancestors and relatives of the dog, while Prof Hobday illustrates canine anatomy by means of sketches Mr Croxton Smith, who writes on the antiquity of the dog appears however, to be unacquainted with all the literature of the subject notably a recent article in *Globus*, by Prof Kraemer, on the St Bernard and the Tibet mastiff

MAJOR POWELL COTTON, who recently arrived in this country, during his journey home communicated to Reuter's Agency at Rome some of the results of his twenty-seven months' sojourn in the heart of Africa According to this account, the explorer secured a specimen of the Central African race of the white rhinoceros near Lado Like other British explorers of the Ituri Forest he failed to see a living okapi, although he approached within twenty yards of one in dense jungle The skeleton and skin of a male and the body-skin of a calf were however, secured, and have now been transferred to the British Museum Important information derived from the Ituri pigmies, with regard to the habits of the okapi is promised in due course Several mammals collected have been described as new by Mr Lydekker They are the black honey-badger and local races or phases of the African tiger-cat water chevrotain, Stuhlmann's elephant-shrew, and a guereza monkey from the Ituri Forest together with a large tawny buffalo from the open Semliki country near the Albert Edward Nyanza Major Cotton has demonstrated that the range of the dwarf red buffalo, the water-chevrotain, and the potamogale extends right across the forest region It may be added that Mr Boyd Alexander has presented to the British Museum the skull and skin of an okapi obtained by his expedition in the southern Bahr-el-Ghazal country

PUBLISHED as parts of the current volume of the Kew Bulletin, appendix ii furnishes a catalogue, with alternate pages left blank, of additions to the library during the year 1906, and appendix iii contains a list of new garden plants for the same year Again a large number of the new plants have been obtained from China being introduced by Messrs J Veitch and Sons, derived from the collections made for them by Mr E H Wilson Four species of Primula are added to a previously long list, among them being the vivid blue-flowered *Primula deflexa* Of new species from Brazil a dozen are recorded, all except *Asplenium laceratum* being orchids

A DISCUSSION mainly theoretical of the much debated question of the water supply in plants by Dr A Ursprung, appears in the *Biologisches Centralblatt* (vol xxvii, Nos

1, 2, and 3) The author is a strong advocate of the important part taken by living parenchymatous cells in the ascent of sap, favouring the view that they act chiefly as intermediate pumping stations. It is noticeable that the explanation offered by Askenasy receives brief consideration, and no mention is made of the papers and investigations contributed to the subject by Dixon and Joly or other British workers.

UNDOUBTEDLY the greatest novelty at the rubber exhibition held in Ceylon last August was the sample of pressed or blocked rubber sent from a plantation in the Malay States. As blocked rubber possesses several advantages over "biscuit" rubber, an early opportunity was taken by Dr. J. C. Willis and Mr. M. K. Bamber to prepare an experimental block with creosote to ascertain whether it was suitable for shipment to Europe. The details of the experiment are given in vol. iv., No. 1, of the Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, from which it will be seen that although the block contained a considerable amount of moisture, the price of the sample compared favourably with the best biscuit.

IT is improbable that students of natural history are sufficiently familiar with Crabbe's poetical works to express an opinion on his descriptions of birds and plants. An article on Crabbe as a poet is contributed by the Rev. J. Vaughan to the February number of the *Monthly Review*, claiming that his descriptions of scenery are characterised by their distinctness and accuracy. The botanical references in his writings are practically confined to the district of Aldeburgh in Suffolk, as in the allusion to the salt-marshes where "Samphire-banks and salt-wort bound the flood," &c. But his interest in botany extended much beyond word painting; he was a keen collector, and knew the haunts of such rare plants as *Trifolium suffocatum*, *Pisum maritimum*, and *Urtica pilulifera*; also several note-books still extant indicate that he ardently followed the progress of knowledge with regard to grasses, sedges, and cryptogams.

THE current issue of the Quarterly Journal of the Geological Society (vol. lxiii., part 1) contains a valuable paper by Mr. W. R. Baldwin-Wiseman on the influence of pressure and porosity on the motion of subsurface water. It contains an able summary of the more important investigations of the behaviour of underground water, and shows that by the careful study of the hydrological map of a district which has been surveyed with some exactitude, it is possible to gain a considerable knowledge of the details of the geological structure of the district which might not otherwise be available, and to obtain at the same time valuable data for the scientific solution of the water-supply problems of that district.

THE recent remarkable development of the American iron industry is discussed in some detail by Mr. E. C. Eckel in the *Engineering Magazine* (vol. xxxii., No. 5). Dealing with the important subject of ore reserves, he shows that, on the assumption that the demand for iron ore during the present century may range from 50 to 100 million tons annually, the Lake Superior district would last for from twenty-five to fifty years more if it supplied the entire United States. But, counting on the known reserves elsewhere in the United States, the ore will last for a much longer period, though, of course, it must necessarily show a gradual but steady increase in value. Electric smelting will, he considers, have little influence on the general development of the iron and steel industries until fuel supplies become more scanty than they are at present. Considerably more practical results to the industry can be expected from the nodulising process of treating ore dust. This process accomplishes both the consolidation and desulphurising of the material, and its chief advantage, as compared with the older briquetting and roasting processes, arises from the fact that the rotary kiln employed is distinctly an effective labour-saving device.

THE remarkable paper which Mr. Dugald Clerk read before the Institution of Civil Engineers on February 26 brings us appreciably nearer a complete understanding of the thermodynamics of the internal-combustion engine. He examined the results of the tests made by the institution committee on the standards of efficiency of internal combustion engines, and gives the results of further experiments on the large engine used in the test, with the view of finding the true heat distribution of the engine. Tables are given showing the ideal efficiencies for different compressions using the specific heat values given, and shows that roughly the air standard is 20 per cent. too high, and that if γ, the ratio of specific heat at constant pressure to specific heat at constant volume, be taken as 1·285 for the explosion line and 1·37 for the compression line, the change of specific heat between 1700° C. and 1000° C. commonly used in practice is too small to produce much error. More investigation is, however, required before even the apparent specific heat values can be accurately known for the various mixtures used in internal-combustion motors. For a given expansion the best engines have approached very closely to the theoretical realisation of their cycle. The complete suppression of all heat losses due to conduction, &c., on the explosion expansion strokes could only increase the indicated power by about 13 per cent. It is satisfactory to find that the gas engine is so nearly perfect.

IN his recent notice of Dr. E. W. Scripture's work on experimental phonetics (February 21, p. 392), Prof. McKendrick pointed out that though mention is made in the work that Prof. Weber, with Prof. Schneebeli, applied the Fourierian analysis to a vowel curve, no date is given when this was done. Dr. C. E. Guillaume, of the Bureau international des Poids et Mesures, Sèvres, who was formerly Prof. Schneebeli's assistant, writes to say that the results of researches on the harmonic analysis of vowel sounds during the summer of 1878 were communicated to the Société des Sciences naturelles de Neuchâtel on November 21 of that year. The paper by Fleeming Jenkin and J. H. Ewing referred to by Prof. McKendrick was communicated to the Royal Society of Edinburgh on June 3 and July 1, 1878, and was published in part iii. of vol. xxviii. of the Transactions, which is dated 1879.

WE have received from Messrs. Shelley W. Denton and Co., 99 Regent Street, W., samples of their patent butterfly tablets, containing handsome tropical butterflies and moths, mounted on a special plaster background, and covered with glass in such a manner as to exhibit the wings, antennæ, &c., to perfection, while preserving the specimens from almost any injury short of the actual breakage of the glass cover or of the tablet itself. We believe the process is American, and have been familiar with Messrs. Denton's method for some years, and we are quite ready to concede that it possesses *most* of the merits claimed for it by the firm in the circular which they have sent us. But when they say that the specimens "preserve their rich colours intact," and "they make magnificent wall, table, or mantel ornaments," we can

only point out that light, especially direct sunlight, is always very destructive to the colours of butterflies (though some colours fade more quickly than others), and though they will preserve their colours fairly well for centuries *if kept from the light*, we should strongly recommend any person who values specimens of butterflies to keep them *carefully covered*, except when actually undergoing inspection

WE have before us copies of the reports of the U S National Museum, Washington, for the years ending June 30, 1905, and June 30, 1906 These reports are for the future to be restricted to accounts of the administrative operations of the museum The interesting and well-illustrated papers based on the collections of the museum which in past years have appeared in the appendix to the reports, are for the future to be published in other series The report for the year ending June 30, 1906 shows that the total number of accessions received by the museum during that year was 1516, comprising 257,605 specimens, of which 8232 were assigned to the department of anthropology, 227,633 to the department of biology, and 21,740 to the department of geology In ethnology, large accessions were received from Arizona and New Mexico, the Philippine Islands, and Malaysia The collections in physical anthropology were mainly enriched by material from Malaysia and from ancient Indian ruins and mounds in the western parts of the United States The most important addition to the biological department was the collection of 75,000 American Lepidoptera given by Mr William Schaus, and, besides these 33,000 insect specimens were received through the U S Department of Agriculture In view of annual additions such as these, it is not surprising to learn that "year by year the exhibition cases have been brought closer and closer together, and great spaces have been shut off from the public view to permit of the shelter of thousands of new accessions" Fortunately, the new building for the museum is making satisfactory progress and its completion will make it possible to reveal to visitors the wealth of scientific material which has been amassed in recent years

THE untrustworthiness of the underground conduit system for tramways when confronted with a heavy snowfall is once more brought to our notice in the reply of the manager of the Grand Berlin Tramways Company to the criticisms passed upon the recent breakdown of the few underground conduit lines in Berlin Assertions were made that with the same system other towns on the Continent were free from interruption to their tramways during the recent fall of snow, but the manager in his reply clearly shows that, with the exception of Vienna, all the leading towns on the Continent in which the underground conduit system is employed were in a similar plight, and in Budapest the tramways were completely stopped for several days The report of the Brussels Tramway Company also states that their troubles during the snowy period were due to the underground conductors, and that the working of the lines could not be carried out with a repetition of similar events, in spite of the fact that a large reserve plant was available Vienna is almost an ideal city for conduit work, and has nothing like the traffic of Berlin, and is not, therefore, a fair comparison of everyday working conditions such as we have in London We have before pointed out in NATURE the difficulties attendant on the working of the underground conduit system directly any unusual weather sets in, and the above reports fully bear out the contention that the underground conduit system is not so perfect as some of its disciples would have us believe

UNDER the title "Erinnerungen an Johannes Wislicenus," Dr W Sonne has published (Leipzig W Engelmann, pp 36, price 1 20 marks) a number of personal recollections of Wislicenus during the years 1876–1881 when, at the height of his activity, he was filling the chair of professor of chemistry at Würzburg It was during this period that his work on ethyl acetoacetate was published, partly in collaboration with Conrad and others In 1880 he was associated with Hantzsch, who succeeded him both at Wurzburg and Leipzig The "Erinnerungen" are of value as throwing light on the inspiring personality of Wislicenus, and may be regarded as supplementing the more complete accounts recently given of Wislicenus's work by Prof Beckmann and Prof W H Perkin, jun

MUCH confusion arises at the present time from the lack of understanding, either here or abroad, as to the exact sense in which the various names applied to proteins and their derivatives shall be used Difficulty is created by the use of a term in different senses, as well as ambiguity of meaning in some cases The Chemical Society has for some time had this matter of nomenclature under consideration and has just issued a series of recommendations in its Proceedings (vol xxiii, No 321) The first two recommendations are —(1) The word proteid —which is used in different senses in this country and in Germany—should be abolished (2) The word protein is recommended as the general name of the whole group of substances under consideration It is at present so used both in America and Germany It admits readily of the use of such derived words as protease and proteose If used at all, the term albuminoid should be regarded as a synonym of protein

MESSRS CROSBY LOCKWOOD AND SON have published a second edition of Mr George Clapperton's "Practical Paper-making" The work has been carefully revised and enlarged by twenty pages so as to bring the information up to date

MESSRS MACMILLAN AND CO, LTD, have issued separately certain parts of "An Introduction to Practical Geography," by Mr A J Simmons and Mr Hugh Richardson which was reviewed in our issue for May 10, 1906 (vol lxxiv, p 27) Section i maps, section ii the globe and section iii, climate, may be obtained in small volumes bound in limp cloth, and the price of each is 1s

THE Bulletins of Miscellaneous Information issued during 1906 from the Royal Botanic Gardens, Kew, have been bound together in a single volume, the price of which is 4s The work can be obtained in London from Messrs Wyman and Sons, Ltd, or through any bookseller Reference has been made to separate bulletins from time to time in these columns, and botanical readers of NATURE are familiar with the general character of the publication

OUR ASTRONOMICAL COLUMN

PERTURBATIONS OF HALLEY'S COMET —From an investigation of the Jupiter perturbations of Halley's comet Messrs Cowell and Crommelin find that the perihelion passage of that comet will probably occur about a fortnight earlier than the date given by Pontécoulant that is, in the first half of May, 1910 What is more important they also find that Pontécoulant's perturbations were about ten times too great, and consequently the perihelion distance will be appreciably the same (0 59) as at the last return, instead of being shifted some nine million miles nearer to the earth as found by the French investigator (Monthly Notices, vol lxvii, No 3 January)

STARS HAVING PECULIAR SPECTRA.—Circular No. 124 of the Harvard College Observatory contains the particulars of a number of variable stars and other objects which the Henry Draper memorial photographs, examined by Mrs Fleming show to have peculiar spectra.

The chief peculiarities are bright or multiple hydrogen lines, as, for example, in the spectrum of B.D. +47° 939, a 4.5 magnitude star in Perseus, in which Hβ is bright and the lines Hγ and Hδ appear to be double, probably because fine bright lines are superposed on them. A star in Scorpio, of magnitude 7.1, is found to have a spectrum similar to that of ζ Puppis. Several of the variable stars mentioned show a range of about five magnitudes.

SIMULTANEOUS DISPARITION OF JUPITER'S FOUR SATELLITES.—From a study of the phenomena of Jupiter's satellites, Signor Enzo Mora finds that on October 3, 1907, all four of the larger moons will be invisible, for several minutes, at the same time, and, as this is a rare occurrence, he directs attention to the matter in No. 4148 of the *Astronomische Nachrichten*. From 7h. 48m. to 7h. 54m. (Greenwich Civil Time) No. 1 will be eclipsed and occulted, No. 2 will be in transit, No. 3 will be eclipsed, and No. 4 occulted. The satellites will again be invisible at 9 p.m. on the same evening. The last time this phenomenon occurred was October 21, 1895, and, after October next, it will not occur again until October 22, 1913.

PHOTOGRAPHS OF FAINT STARS.—In Circular No. 123 of the Harvard College Observatory Prof. E. C. Pickering outlines a plan by which the information to be gathered from photographs of stellar regions, taken by numerous observers in various countries, may become readily available to anyone in search of such information. For stars of the thirteenth magnitude and brighter, the Harvard collection of photographs largely supplies the necessary data. For example, for each of the stars of magnitude 5.0 and brighter, some 2000 in number, the collection contains about one thousand photographic images taken during the last twenty years; similarly, for the thirteenth magnitude stars, about five million in number, there are about 200 images of each.

Prof. Pickering now suggests that anyone having in their possession photographs which might furnish useful information, such as the earlier appearance of Novæ, variable stars, &c., should publish particulars of the same, or should forward to him the necessary information in order that it may be included in a publication which the Harvard authorities are preparing, and so become available generally.

MODEL TO ILLUSTRATE EFFECTS OF THE EARTH'S ROTATION.—In No. 7 (February, 1907) of the *Comptes rendus* M. G. Blum describes a simple apparatus for reproducing the phenomena observed in the Foucault-pendulum experiment for showing the earth's rotation. Briefly, the apparatus consists of a sphere representing the earth and a small pendulum which may be made to oscillate on its surface in any latitude. The sphere rotates on an axis, and is slotted along a meridian so that the gallows carrying the pendulum may be clamped on to it at different points representing different latitudes. The oscillation of the pendulum—which consists of a thin wooden rod with a small wooden bob—is produced by a coiled spring, and always takes place in a plane normal to the sphere. With this apparatus the rotation of the plane of oscillation with regard to that of the sphere may be shown to be equal in period and opposite in sense at the poles, and to have a slower period as it approaches the equator, the change being so marked that it can be readily seen and its nature recognised.

PROMINENCE OBSERVATIONS (1906).—No. 1, vol. xxxvi. (1907), of the *Memorie della Società degli Spettroscopisti Italiani* contains a posthumous note of Prof. Mascari giving the results of the solar-prominence observations made at Catania during the first half of 1906. Three hundred and forty prominences were observed on eighty-seven days, giving a daily frequency of 3.91. In the northern hemisphere the daily frequency was 2.32 and the mean heliographic latitude 31°.6, the corresponding figures for the southern hemisphere being 1.59 and 29°.2 respectively.

METEOROLOGICAL OBSERVATIONS.

SUNSHINE and Snowfall in 1906.—In *Symons's Meteorological Magazine* for January, Mr. R. H. Curtis gives an interesting summary, with map, of the bright sunshine over the British Isles, registered by the Campbell-Stokes (burning) recorder. The year was one of the sunniest on record; the most favoured region was the English Channel, all stations from Torquay to Lowestoft recording approximately 2000 hours of sunshine. At inland stations the amount became less, yet, broadly speaking, all the region south of a line drawn from the Humber to the Bristol Channel received 200 hours more than the yearly average. In north-west Scotland the amount was below 1200 hours, which was not far from the average of that district. The most brilliant months (relatively to their possible amounts) were February, April, June, July, and September; the most sunless months were May and November, in both of which the amounts recorded were generally below the average.

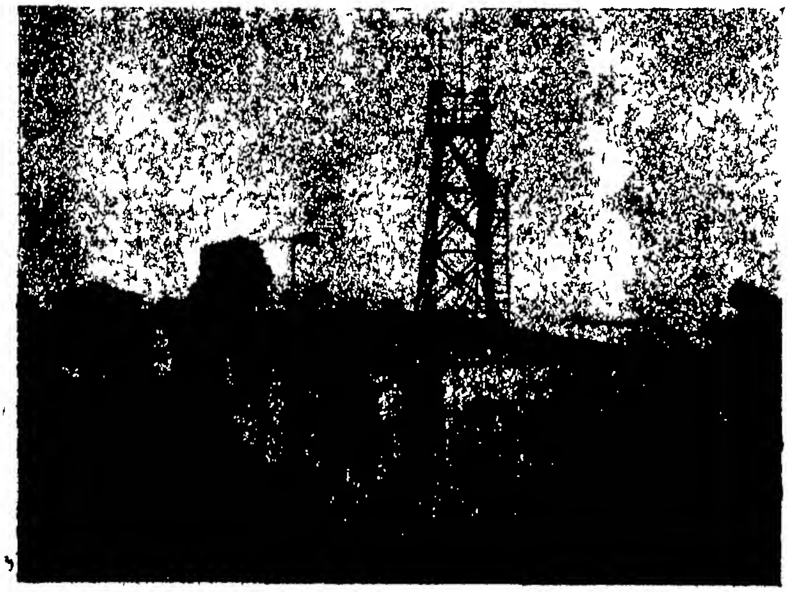
The snowfall is preliminarily dealt with by the editor, with especial reference to the storms between December 25–30, which occurred over nearly the whole of the British Isles. Considerably more than half the kingdom received above 5 inches, and some districts, especially north-east England and the southern uplands of Scotland, from 1 foot to 2 feet in depth. In the south of Scotland trains were blocked; Aberdeen was isolated for several days, and a most serious railway collision occurred near Arbroath. Although the greatest amounts recorded were in Scotland, Dr. Mill points out that the severity of the storm in Ireland, where more than a foot was recorded in the north and west, was noteworthy, owing to its usual immunity from heavy snowfalls, an amount of 5 inches over wide districts being very unusual there.

Rainfall of Scotland in May, 1906.—In discussing this subject in the Journal of the Scottish Meteorological Society, Mr. A. Watt shows that the rainfall of Scotland in that month was of a very exceptional character; in the eastern districts, generally, the fall was much the heaviest in May during the last fifty years. The rainfall on the east coast was heavier than that on the west; only a few scattered stations towards the north-west did not receive as much as 3 inches, about nine-tenths of the mainland received at least 4 inches, while a large area in the south and south-east and other isolated parts received 6 inches and upwards, or about thrice their normal amount. A note by Mr. R. C. Mossman on the conditions experienced by himself in the Greenland Sea during the month in question shows that the weather there was unusually inclement; the characteristic features were high barometric pressure, accompanied by strong north-west and north winds and gales, very low mean temperature, and densely overcast skies. Mr. Mossman states that there can be little doubt that the Arctic anticyclone was the dominating factor in the production of the abnormal rainfall in Scotland, and also of the unusually high temperatures observed in Russia at the same time, referred to in Mr. Watt's paper.

The Atmosphere in the Tropics.—In the Proceedings of the American Academy of Arts and Sciences for December, 1906, Mr. A. L. Rotch gives the results of the Franco-American expeditions undertaken at the expense of M. Teisserenc de Bort and himself to prove, by means of kites and unmanned balloons, the direction of the upper return currents above the trade-wind region of the North Atlantic. For this purpose M. Teisserenc de Bort purchased and equipped the steam yacht *Otaria*, of 350 tons, and expeditions were made in the summer of 1905 and in the winter (February) of 1906. With regard to the results of the first expedition, Mr. Rotch states:—(1) north of Madeira and near the Azores the upper winds are chiefly from west and north-west; (2) winds blowing towards the equator are from north-east to east in the lower region, and generally from north-west to north-east above 1000 metres; (3) the return currents from the equator, or anti-trades, are formed by winds having a southerly component, being generally south-west in the latitude of the Canaries, and south-east near the Cape Verdes. As most of the observations of direction of the upper currents found by Prof. Hergesell during the cruises of the *Princesse Alice*

in 1904–5 differ radically in showing no southerly component, the *Otaria* was sent again to the south and west of the region which had been explored in the preceding summer. Mr. Rotch states that the upper anti-trade is shown both by the balloons and the drift of the clouds between 3000 metres and 4000 metres, and that the classic observations of the return trade on the Peak of Teneriffe indicate a general phenomenon, and agree with those obtained over the open ocean by the recent expedition Prof. Hergesell's remarks upon this subject were referred to in NATURE of December 27, 1906 (p. 211).

Meteorological Observations on the Summit of the Tsukubasan, Japan.—The establishment of this first-order observatory, and the determination of the force of gravity and exact geographical position, are due to the interest taken in physical science by H.I.H. Prince Yamashina. The observatory is situated on the most westerly peak of the mountain, in lat. 36° 13′ 21″ N., long. 140° 5′ 47″ E., about forty miles north-east of Tokio, at an altitude of 2852 feet. It commands the view of the surrounding district for many miles to the north and west, while to the south and east it has an open view of the wide expanse of the Pacific Ocean. Its position is therefore extremely favourable for studying the conditions of the atmosphere at that height. As connecting links, intermediate stations have been established near the little village of Tsukuba, at an altitude of 787 feet, and at the base of the south-west of the mountain, 98 feet above sea level. The illustration represents the peak observatory, which is constructed of wood and zinc, the main objects being durability and usefulness, without any attempt at ornamentation. On the roof are seen the rain-gauges, lightning conductor, and wind-vane, close to the main building, on the north-east, stands a steel tower carrying another lightning conductor, anemometers for recording both horizontal and vertical movements of the wind, and a sunshine recorder, while the thermometer screen is seen to the south-west of the building. It goes without saying that the instruments are of the best make, although the sunshine recorder is of the photographic (Jordan) type, not the burning (Campbell-Stokes) pattern. The latter instrument alone is now used at the stations of the British Meteorological Office, as giving strictly comparable results. The observing staff consists of a director and five assistants, at the time of the publication of the first report, for the year 1902, the observatory and subsidiary stations were under the supervision of Mr. Okada, adjunct of the Central Meteorological Office at Tokio, the control of the observers and other details being undertaken by Mr. J. Sato, chief observer at the peak station. The computation of the mean and extreme values for 1902 from hourly readings for all three stations, and tables showing the ranges and wind frequency and velocity, are carefully prepared, but no general textual summary of results is given. At the base station only the rainfall observations are complete for the year, the total fall was 63.72 inches, and at the peak station 62.82 inches. The absolute ranges of the barometer at the summit and intermediate stations were practically the same, being 1.87 inches and 1.78 inches respectively. The mean annual temperatures at these two stations were 48°.2 F. and 55°.2 F., and the absolute ranges 59°.2 and 37°.4 respectively. The resulting wind direction at the summit, computed from the records of a Robinson's anemometer, was N. 82° E., resultant velocity 0.39 metre per second (0.87 mile per hour), the mean hourly velocity, irrespective of direction, was approximately 17.2 miles.



The Meteorological Observatory on the Tsukubasan.

Meteorology of India.—The Meteorological Department of India has issued a memorandum on the weather conditions during October and November, 1906, with a forecast of the rainfall in northern India and of the snowfall on the neighbouring mountain areas during the cold weather of 1906–7. Dr. Walker states that on the average of the whole country there was a defect of 22 per cent. in the rainfall of October and of 20 per cent. in November. The temperature conditions were determined by the distribution of rainfall, in the latter month the weather was unusually warm over practically the whole of the country, and especially in the North-Western Provinces. From information available, the snowfall also appears to have been less than usual. Among other factors affecting the cold-weather season, the director points out (1) that the active state of the sun during the past year is an element that should be taken into account, the number of sun-spots observed in 1906 is in moderate excess, which fact, if taken alone, suggests that a severe winter is rather more likely than a mild one. (2) That the mean of the departures of November rainfall at Zanzibar and Seychelles is −1.8 inches, which taken by itself suggests that the approaching cold-weather precipitation may be somewhat lighter than usual. All things considered, the final conclusion is that there is no reason for expecting any large departure from normal conditions.

Meteorological Observations in Cape Colony.—The report of the Meteorological Commission for the year 1905 shows that a large amount of useful work is being carried out in rather adverse circumstances. The sum received from the Parliamentary Grant for the year did not exceed 862*l.*, the supply of instruments and reduction of anemometrical and other observations have consequently been curtailed, while no general inspection of stations has been made since 1901. The results are published for a large number of ordinary meteorological and rainfall stations, some of which belong to adjacent territories outside the boundaries of Cape Colony; the report also contains a useful monthly chronicle of the weather by Mr. C. M. Stewart (secretary), and special tables of the maximum daily rainfall at various stations. The mean rainfall for the year, deduced from all the stations, was 23.77 inches, occurring on sixty-five days; the amount was only about 0.1 per cent. below the average for 1885–1894, and was an increase of 3.61 inches above the mean for 1904. The four largest records in one day were 11.33 inches at Evelyn Valley, on October 10, 10.70 inches at Durban, on June 1, 10.37 inches at Vogel Vlei, on April 9, and 10.18 inches at Forestbourne, on October 10. Thunder storms were unusually frequent in December and practically absent in July. The highest temperature recorded was 119°.5 at Main, on November 19, and the lowest

17°·0 at Moyeni, Basutoland, on August 23. The mean yearly value of the absolute maxima was 86°·9, and of the corresponding minima 41°·6. The mean temperature for the year was 0°·9 below the average. The stormiest month was October, and the calmest was April.

We have also received the official meteorological year-books for South Australia (1904) and Mysore (1905). Both of these works contain valuable means for previous years.

Forty Years of Southern New Mexico Climate.—Bulletin No. 59 of the New Mexico College of Agriculture contains the meteorological data recorded at the experimental station from 1892 to 1905 inclusive, together with results of temperature and rainfall observations at other stations in the Mesilla Valley for most of the years between 1851 and 1890 published some years ago by General Greely in a "Report on the Climate of New Mexico." The station is situated in lat. 32° 15′ N., long. 106° 45′ W., and is 3868 feet above sea-level. The data have a general application to those portions of southern New Mexico with an altitude less than 4000 feet. The mean annual temperature for the whole period was 61°·6; mean maximum (fourteen years) 76°·8, mean minimum 41°·4, absolute maximum 106° (which occurred several times), absolute minimum 1° (December, 1895). The mean annual rainfall was 8·8 inches, the smallest yearly amount was 3·5 inches, in 1873, the largest 17·1 inches, in 1905. Most of the rain falls during July, August, and September. The relative humidity is low, the mean annual amount being about 51 per cent. The bulletin was prepared by J. D. Tinsley, vice-director of the station.

Meteorological Observations in Germany.—The results of the observations made under the system of the Deutsche Seewarte, Hamburg, for 1905, at ten stations of the second order and at fifty-six storm-warning stations, have been received. This is the twenty-eighth yearly volume published by the Seewarte, and forms part of the series of German meteorological year-books. We have frequently referred to this excellent series, and the volume in question is similar in all respects to its predecessors; it contains most valuable data relating to the North Sea and Baltic coasts. We note that the sunshine at Hamburg was only 29 per cent. of the possible annual amount, and that there were 103 sunless days; the rainfall was 25·9 inches, the rainy days being 172 in number.

VOX POPULI.

IN these democratic days, any investigation into the trustworthiness and peculiarities of popular judgments is of interest. The material about to be discussed refers to a small matter, but is much to the point.

A weight-judging competition was carried on at the annual show of the West of England Fat Stock and Poultry Exhibition recently held at Plymouth. A fat ox having been selected, competitors bought stamped and numbered cards, for 6*d*. each, on which to inscribe their respective names, addresses, and estimates of what the ox would weigh after it had been slaughtered and "dressed." Those who guessed most successfully received prizes. About 800 tickets were issued, which were kindly lent me for examination after they had fulfilled their immediate purpose. These afforded excellent material. The judgments were unbiassed by passion and uninfluenced by oratory and the like. The sixpenny fee deterred practical joking, and the hope of a prize and the joy of competition prompted each competitor to do his best. The competitors included butchers and farmers, some of whom were highly expert in judging the weight of cattle; others were probably guided by such information as they might pick up, and by their own fancies. The average competitor was probably as well fitted for making a just estimate of the dressed weight of the ox, as an average voter is of judging the merits of most political issues on which he votes, and the variety among the voters to judge justly was probably much the same in either case.

After weeding thirteen cards out of the collection, as being defective or illegible, there remained 787 for discussion. I arrayed them in order of the magnitudes of the estimates, and converted the *cwt.*, *quarters*, and *lbs.* in which they were made, into lbs., under which form they will be treated.

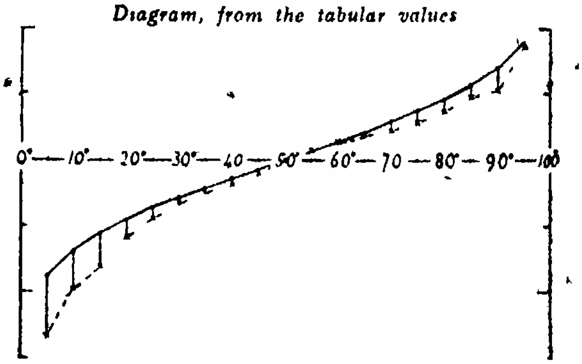
Distribution of the estimates of the dressed weight of a particular living ox, made by 787 different persons.

Degrees of the length of Array 0°–100°	Estimates in lbs.	Centiles: Observed deviates from 1207 lbs.	Centiles: Normal p.e. = 37	Excess of Observed over Normal
5	1074	−133	−90	+43
10	1109	−98	−70	+28
15	1126	−81	−57	+24
20	1148	−59	−46	+13
q_1 25	1162	−45	−37	+8
30	1174	−33	−29	+4
35	1181	−26	−21	+5
40	1188	−19	−14	+5
45	1197	−10	−7	+3
m 50	1207	0	0	0
55	1214	+7	+7	0
60	1219	+12	+14	−2
65	1225	+18	+21	−3
70	1230	+23	+29	−6
q_3 75	1236	+29	+37	−8
80	1243	+36	+46	−10
85	1254	+47	+57	−10
90	1267	+52	+70	−18
95	1293	+86	+90	−4

q_1, q_3, the first and third quartiles, stand at 25° and 75° respectively.
m, the median or middlemost value, stands at 50°.
The dressed weight proved to be 1198 lbs.

According to the democratic principle of "one vote one value," the middlemost estimate expresses the *vox populi*, every other estimate being condemned as too low or too high by a majority of the voters (for fuller explanation see "One Vote, One Value," NATURE, February 28, p. 414). Now the middlemost estimate is 1207 lb., and the weight of the dressed ox proved to be 1198 lb.; so the *vox populi* was in this case 9 lb., or 0·8 per cent. of the whole weight too high. The distribution of the estimates about their middlemost value was of the usual type, so far that they clustered closely in its neighbourhood and became rapidly more sparse as the distance from it increased.

Diagram, from the tabular values.



The continuous line is the normal curve with p.e. = 37.
The broken line is drawn from the observations.
The lines connecting them show the differences between the observed and the normal.

But they were not scattered symmetrically. One quarter of them deviated more than 45 lb. above the middlemost (3·7 per cent.), and another quarter deviated more than 29 lb. below it (2·4 per cent.), therefore the range of the two middle quarters, that is, of the middlemost half, lay within those limits. It would be an equal chance that the estimate written on any card picked at random out of the collection lay within or without those limits. In other words, the "probable error" of a single observation may be reckoned as ½(45+29), or 37 lb. (3·1 per cent.). Taking this for the p.e. of the normal curve that is best adapted for comparison with the observed values, the results are obtained which appear in above table, and graphically in the diagram.

The abnormality of the distribution of the estimates now becomes manifest, and is of this kind The competitors may be imagined to have erred *normally* in the first instance, and then to have magnified all errors that were negative and to have minified all those that were positive The lower half of the "observed" curve agrees for a large part of its range with a normal curve having the p.e = 45, and the upper half with one having its p e = 29 I have not sufficient knowledge of the mental methods followed by those who judge weights to offer a useful opinion as to the cause of this curious anomaly It is partly a psychological question, in answering which the various psychophysical investigations of Fechner and others would have to be taken into account Also the anomaly may be partly due to the use of a *small* variety of different methods, or formulæ, so that the estimates are not homogeneous in that respect

It appears then, in this particular instance, that the *vox populi* is correct to within 1 per cent of the real value, and that the individual estimates are abnormally distributed in such a way that it is an equal chance whether one of them, selected at random, falls within or without the limits of −3 7 per cent and +2 4 per cent of their middlemost value

This result is, I think, more creditable to the trustworthiness of a democratic judgment than might have been expected

The authorities of the more important cattle shows might do service to statistics if they made a practice of preserving the sets of cards of this description, that they may obtain on future occasions, and loaned them under proper restrictions, as these have been, for statistical discussion The fact of the cards being numbered makes it possible to ascertain whether any given set is complete

FRANCIS GALTON

THE WORK OF THE OPTICAL SOCIETY [1]

THOUGH it is perhaps seldom that the Transactions of the Optical Society contain much record of original research, yet they often furnish matter of considerable value to the practical optician, and will usually be found to contain more than one paper of importance to the student of optics The first paper in the present volume will have interest for many readers It is a short and clear statement, by one well qualified to judge, Mr W A Dixey, of the case for the use of periscopic lenses in spectacles A periscopic lens, as defined by Mr Dixey, is one through which its wearer can look obliquely as well as directly without his vision being impaired by radial astigmatism The result is attained either by deepening the curves of the lens so as to produce an approximation to a sphere the centre of which coincides with the centre of rotation of the eye, or by the use of toric lenses A careful reading of Mr Dixey's paper would probably lead many wearers of spectacles to pay another visit to the optician

The paper by Mr Theodore Brown, on direct stereoscopic projection, is of special interest It describes an ingenious device for obtaining stereoscopic effects in pictures projected on a screen, of which probably more will be heard. The argument is that in binocular vision the stereoscopic effect is due to the fact that the two images of the same object in the two eyes are not formed in similar positions on the retina, and that it should be possible to produce stereoscopic effects even when one eye only is used if by some means two simultaneous pictures can be formed on the retina in appropriate positions Owing to the permanence of retinal impressions, this can be effected by throwing on the screen with rapid alternation the two stereoscopic pictures in somewhat displaced positions The displacement is produced by giving a motion to the projection camera, and the stereoscopic can be combined with the "bioscopic" effect by the use of a kinematograph mechanism It is clear from the paper and the discussion that further perfection of detail is necessary to produce completely satisfactory results but there seems no reason why the difficulties should not be overcome There is, however, some reason for suggesting that perhaps a one-eyed spectator would be the most appreciative

In "A Method of Testing Prisms," Mr S D Chalmers, the head of the optical department at the Northampton Institute, suggests some useful applications of the method of auto-collimation for the determination of the angles of prisms to the highest possible accuracy We would direct attention especially to the procedure suggested for the measurement of one of the angles of a 60° prism ABC Rays entering perpendicular to the face BC are totally reflected at 30° from CA or AB, and reflected normally at AB or CA, emerging again approximately perpendicular to BC From the separation of the incident and emergent rays the error in the angle A can be determined Only one reflection takes place normally at a glass-air surface, and there is, therefore, no difficulty in seeing the image Simultaneous observation of the direct reflection from BC aids in setting the prism A similar method can readily be applied in other instances and the figures in the paper suggest at once the procedure in the cases which occur most frequently The lack of parallelism in plane parallel glass can also be tested in this manner Rigidity is, of course, essential in the apparatus to be employed for the observations, and Mr Chalmers has obviously given some attention to details in the construction of a suitable auto-collimator, drawings or diagrams of this would have added to the value and interest of the paper

Mr I W Phillips, student member, in a paper on the measurement of absorption in tinted glasses, describes some observations on the absorption of light by coloured glasses, such as are used for spectacles, a "flicker" photometer being employed for the measurements The method does not admit of great accuracy but is no doubt useful within certain limits for rough work of the kind suggested It raises, however, some vexed questions as to the photometry of coloured lights and some points of interest in relation to the "flicker" instrument were brought up in the discussion by Dr Garnett and others

A presidential address by Prof Silvanus P Thompson, on the early literature of optics, demands no more than passing mention here, great though its interest must have been to those who had the pleasure of listening to it The volume closes with a contribution by Mr A I Bull entitled "Some Notes on the Nature of Vision" The paper, being essentially of the nature of notes, passes rapidly over many points of interest in connection with the mechanism of vision and the molecular and other phenomena accompanying it Various topics are thus touched on from the accuracy of the photometric results obtained with rotating sectors to the difficulties yet requiring explanation on the Darwinian theory in regard to the process of evolution of vision The notes are suggestive, but would make more interesting reading if less loosely put together

We would venture to suggest, in conclusion, that the editing of the volume leaves something to be desired It may be possible to interpret such phrases as "beep lenses on the Willaston principle," and to escape being deceived by the "dissimulation" of a photochemical body, but the fact that Lewis Carroll was a mathematician does not sufficiently justify such imitation of his playful extravagances in a scientific journal, and the volume is marred by many such misprints

THE COMPRESSIBILITY OF CRYSTALLINE ROCKS [1]

THE latter-day revival of interest in geological physics has led to a keen demand for experimental data the absence of which has hitherto rendered futile most speculation in this domain Our almost complete ignorance of the simplest physical constants of rocks and the rock-forming minerals is easy to account for The kind of investigation required is both difficult and laborious, calling for skill and practice as well as the appliances of a well-equipped physical laboratory and the geologist may lack either the capacity or the opportunity for such re-

[1] Transactions of the Optical Society, London, Session 1904–5 Pp 93 Price 10s

[1] "An Investigation into the Elastic Constants of Rocks more Especially with Reference to Cubic Compressibility" By Prof Frank D Adams and Prof Ernest G Coker Pp 69. (Washington, D C Carnegie Institution, 1906.)

searches On the other hand, the professed physicist, interested in the properties of matter from a more general point of view, prefers to work on materials of a more tractable nature than those with which the geologist is concerned

The memoir before us, the joint work of a geologist and an engineer, deals with the constants of elasticity of a number of crystalline rocks, and gives the results of a series of experiments made in the laboratories of McGill University at Montreal The quantities investigated are among the prime desiderata of geological mechanics, being involved in the calculation of the velocity of propagation of earthquake shocks and in other important questions The only data of this kind previously published seem to be open to serious criticism, and the contribution by Profs Adams and Coker is specially opportune and welcome

The authors describe the method employed and the precautions taken to ensure such accuracy as is possible The rock is cut to the shape of a column 3 inches high and 1 inch in diameter, either square or circular in cross-section The column is subjected to pressure applied perpendicularly upon its ends, and the resulting longitudinal compression and lateral extension are observed In this way are obtained Young's modulus, E (the longitudinal stress divided by the longitudinal compression), and the ratio (m) of longitudinal compression to lateral extension (*i e* the reciprocal of Poisson's ratio) The modulus of cubical compression (D) is then calculated from the relation

$$D=\tfrac{1}{3}\left(\frac{m}{m-2}\right)E,$$

and the modulus of shear (C) from

$$C=\tfrac{1}{2}\left(\frac{m}{m+1}\right)E$$

From the theoretical point of view these equations do not seem to be fairly applicable to the case in hand A crystalline rock is an aggregate of many crystals, each of which is anisotropic, and in the case of such a rock as granite the crystals belong to a number of distinct minerals, differing as regards their elastic constants The argument that an average isotropic effect will result from the random orientation of a large number of anisotropic crystals is not quite convincing Nevertheless, the results found are reasonable and consistent, and go far towards justifying the method adopted

When the relation of strain to stress is plotted on a diagram, it is seen in every case that the progressive loading gives a curve not very different from a straight line, while the corresponding line for unloading is a curve lying very near the other, and returning to the initial point It follows that the rocks examined approximate nearly to perfect elasticity, and obey Hooke's law somewhat closely, and with small hysteresis, for pressures ranging up to 10 000 lb or even 15,000 lb to the square inch Many of them compare favourably in these respects with cast iron We quote some of the results obtained for the seventeen rocks examined The figures are to be multiplied by 10^{11} to give the measure in C G S units —

	D	C
Cast iron	6 897	4 132
Carrara marble	4 090	2 171
Peterhead granite	3 300	2 340
Quincy granite	2 750	1 916
Nepheline syenite, Montreal	4 290	2 505
New Glasgow Anorthosite	5 760	3 275
Sudbury diabase	7 329	3 700

It appears that the granites offer less resistance, both to compression and to shearing, than the basic igneous rocks The authors connect the greater compressibility of the granites with the presence of quartz, but the granites appear to be actually more compressible than that mineral We should suppose rather that the alkali-felspars, which constitute the greater part of an ordinary granite, are notably more compressible than the ferro-magnesian silicates and lime-felspars, and this seems to be confirmed by the intermediate value found for the nepheline-syenite[1] The general character of the rocks which compose the bulk of the earth's crust is doubtless fairly represented by the crystalline igneous rocks selected for investigation, and the average compressibility must lie between the highest and lowest values tabulated above. A simple average of all the igneous rocks examined gives a modulus of compressibility $4\cdot374\times10^{11}$, which is slightly less than that for plate glass. In such an average the acid rocks are probably over-represented, and the value consequently too low.

A. H.

[1] The authors cite Voigt's value for the compressibility of quartz. The more accurate determination by Amagat gives 4 212 in terms of the unit adopted above For the felspars there are no known data.

CYANOGENESIS IN PLANTS AND THE CONSTITUTION OF PHASEOLUNATIN

SINCE 1900 a considerable number of plants yielding prussic acid have been investigated in the Scientific and Technical Department of the Imperial Institute Among these are *Lotus arabicus*, a plant which grows commonly along the valley of the Nile, *Sorghum vulgare*, widely cultivated as a cereal in tropical countries, the Lima bean (*Phaseolus lunatus*), common flax, and cassava (*Manihot utilissima*) The source of prussic acid in each of these cases has been proved to be a glucoside, which in the presence of water is decomposed by an enzyme, also occurring in the plant, yielding prussic acid, glucose, and a third neutral substance Three of these glucosides have been fully studied by Prof Dunstan and Dr Henry Lotusin, $C_{28}H_{31}O_{16}N$, from *Lotus arabicus*, is comparatively complex in structure, and is the lotoflavin ether of maltose cyanohydrin, lotoflavin being a yellow colouring matter isomeric with fisetin and luteolin, and belonging, like these, to the quercetin group of dyes Dhurrin, $C_{14}H_{17}O_7N$, from *Sorghum vulgare*, is a dextrose ether of parahydroxybenzaldehyde cyanohydrin Phaseolunatin, $C_{10}H_{17}O_6N$, which occurs in the Lima bean, flax, and cassava, has been shown to be a dextrose ether of acetone cyanohydrin (Phil Trans, 1901, B, 515, 1902, A, 399, Proc Roy Soc, 1903, lxxii, 285, 1906, lxxviii 145 and 152 British Association Reports, 1906, and *Ann Chim Phys*, 1907, [viii], x, 118)

In a paper communicated to the meeting of the Royal Society held on February 28, the same authors, in conjunction with Dr Auld, gave the results of some further investigations carried out with the object of determining the nature of the dextrose residue present in phaseolunatin

Fischer and others have shown that glucosides are divisible into two classes, derived respectively from the α and β forms of the hexoses, and that the glucosidolytic enzymes which occur in plants also belong to two groups the one, typically represented by maltase, being capable of decomposing α-glucosides, and the other, of which emulsin is the best known, having the power of hydrolysing β-glucosides From the results of the examination of the sugar initially produced when phaseolunatin is hydrolysed by the enzyme, which occurs in association with it in the Lima bean, it is clear that this is α-dextrose, and, therefore, that phaseolunatin is the α-dextrose ether of acetone cyanohydrin It is the first naturally occurring glucoside of this type so far known

This conclusion has rendered necessary a further investigation of the enzymes, which occur with phaseolunatin in the Lima bean, the flax plant, and cassava The mixture of enzymes, prepared in the usual manner from the Lima bean, decomposes amygdalin and salicin, and may therefore be assumed to contain emulsin The latter, prepared from sweet almonds, has, however, no action on phaseolunatin, and this is in harmony with the constitution now assigned to the latter glucoside, since the emulsin of almonds has been shown to hydrolyse only glucosides containing β-sugar residues

It has now been found that the Lima bean contains, in addition to emulsin, a second enzyme, which is of the maltase type, and that the decomposition of phaseolunatin, which takes place when the beans are ground up in water, is due to the action of the maltase-like enzyme The maltase of yeast is also capable of decomposing phaseolunatin, so that the enzyme which occurs in the Lima bean appears to be of the same type as the maltase present in yeast

The mixtures of enzymes occurring in association with phaseolunatin in the flax plant and in cassava have also been investigated and found to behave in the same manner as the mixture of enzymes prepared from the Lima bean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr R C Punnett has been re-elected for three years to a fellowship at Gonville and Caius College, in recognition of his researches in zoology, and Mr C. M Doughty, the distinguished Arabian traveller, author of "Arabia Deserta" and other works, has been elected an honorary fellow of the same college

The general board of studies will proceed shortly to the appointment of a university lecturer in pathology in connection with the special board for medicine, to hold office until December 31, 1911 The annual stipend is 100*l* Candidates are requested to send their applications, with testimonials, on or before Tuesday, March 12

Prof A C Seward, professor of botany, has been nominated to represent the University at the celebration of the three-hundredth anniversary of the death of Ulisse Aldrovandi, to be held in Bologna in June

The council of the Senate has appointed Prof G Sims Woodhead as the representative of the University of Cambridge on the council of the Lister Institute of Preventive Medicine, in the place of the late Sir Michael Foster

The general board of studies has appointed Dr G S Graham Smith to be university lecturer in hygiene for the five years from January 1, 1907 to December 31, 1911, and the appointment has been confirmed by the special board for medicine

The governing body of Gonville and Caius College proposes in June next to make an election to the Sir Thomas Gresham research studentship in economics The value of the studentship will be 120*l* a year Candidates for the studentship must be more than twenty-one and under twenty-five years of age on the first day of October 1907 The election will not be made on the result of a competitive examination Applications should be made before June 1 to the master (the Rev F S Roberts), who will be glad to supply further information

The general board of studies has received a memorandum from the board of agricultural studies embodying a statement presented to that board by the forestry committee of the board to the effect that the committee has during the past year made efforts to obtain such contributions from public bodies and individuals interested in the subject, and is able to report that the efforts have met with a gratifying response The board is now assured of grants for various terms of years amounting to upwards of 500*l* These there is reason to expect will in most cases be renewed Donations or promises of donations have also been received from other contributors amounting to a considerable sum, and a beginning has been made in the collection of specimens for a forestry museum The general board is of opinion that for the proper organisation of this instruction, in addition to the teaching already provided in connection with the Department of Agriculture the services of two special teachers are required One of these should be a forestry expert, capable of assuming the general direction of the students' work, of advising the committee and other bodies, such as colleges and local education authorities, on technical subjects and of promoting study and research in forestry The board thinks that he should have the status of a reader and should have a stipend of 400*l* The other teacher should have a particular branch or branches assigned to him and should be a university lecturer The board of agricultural studies accordingly desires to submit a series of proposals to the Senate embodying these recommendations

The appointments board has presented to the Senate the report for the year 1906 In the year ending December 31, 1906, 136 appointments were obtained on the introduction of the appointments board, by graduates on the register. These appointments include appointments of a public character at home and abroad, as well as industrial and technical appointments, engineering appointments, administrative appointments on railways, appointments for scientific work of various kinds, and lectureships in university colleges. The board has decided in future to make recommendations for scholastic appointments, and some progress has already been made in this direction

DR J M BEATTIE, senior assistant to the professor of pathology, University of Edinburgh, has been elected by the council of the University of Sheffield to the chair of pathology in succession to Dr Cobbett, who has resigned the chair on his appointment as lecturer on bacteriology at Cambridge.

AN official fellow in natural science will shortly be appointed by the principal and fellows of Jesus College, Oxford. The fellow will be expected to teach one of the larger subjects recognised in the honour school of natural science, to undertake the entire direction of the science tuition of the college, and generally to superintend the college laboratory, now in course of erection, this, when completed, will be adapted for the teaching of chemistry and physics The stipend will be not less than 450*l* per annum, together with the free use of rooms in college, and the usual allowances Further particulars may be obtained by application to the principal, Jesus College, Oxford

THE Copenhagen correspondent of the *Times* reports that at a meeting in that city on February 26 the proposal to establish a second university for Denmark at Aarhuus equal to that existing in Copenhagen, was supported by well known men of science and politicians alike Though the sympathy with the new university idea is very great, the correspondent says a Bill can hardly be laid before the present Parliament, which closes its session within four or five weeks In view of the satisfactory state of the national finances, however, it is said to be probable that ultimately a new university will be erected at Aarhuus

THE Prince of Wales presided at a special meeting of the Royal Commission for the Exhibition of 1851 at Marlborough House on February 28 when a resolution was passed granting a site on their estate at South Kensington for the erection of the proposed Royal Institute of Technology The commissioners have also granted a site on their estate for the Institute of Medical Sciences (University of London) It is understood that the site will be reserved for a period of one year, during which it is hoped that the additional sum of about 30,000*l* required to build and equip the institute may be obtained

A LETTER has been addressed to the President of the Board of Education by the Vice Chancellor of the University of London expressing satisfaction that although it has not been found practicable to accept proposals for the immediate incorporation in the University of the new technological institution at South Kensington, the course of action proposed will tend to facilitate the accomplishment at an early date of the objects the Senate of the University has in view The Senate fully appreciates the disadvantages which would attend any further delay in the establishment of the new college The Vice-Chancellor concludes his letter by expressing the hope that during the time before the appointment of the Royal Commission proposed by the President of the Board of Education, the new governing body and the Senate may find themselves, as a result of friendly discussion, in a position to submit to the Board joint proposals for complete incorporation, and so avoid the need for a commission

THE late Mr C J Oldham a well-known ophthalmic surgeon left large bequests for educational purposes These gifts include —10,000*l* to the principal and three other members of the governing body of Corpus Christi College, Oxford as trustees, to be applied as to one-third in the award of scholarships for proficiency in or furthering the study of classics, and as to the remaining two-thirds to be applied to the advancement of general learning in that college, 5000*l* to the University of Oxford 5000*l* to the University of Cambridge each of these bequests to be applied to the encouragement of the study of Latin and Greek and to the works of Shakespeare and 3000*l* to the Manchester Grammar School The residue of the testator's property, which will apparently amount to between 15,000*l* and 20,000*l*, is left as one-half to Corpus Christi College, Oxford, and one-half to Manchester Grammar School

THE annual meeting of the Institute of Chemistry was held on March 1 Prof P F Frankland F R S, president, was in the chair The report which was adopted,

shows that the institute now has 1016 fellows and 177 associates The president, in his address, said the most important feature of the year's work has been the inauguration of examinations in chemical technology The council believes that the institution of these examinations will materially help fellows and associates to obtain employment in chemical industries Another piece of work accomplished has been the publication of a list of official chemical appointments Commenting on the value of the qualifications of the associateship and fellowship of the institute, the president showed how the examinations of the institute differ from those of the universities The latter he said, are contrived to test the amount of knowledge which a candidate has succeeded in bringing to a focus at a particular moment, while the main object of the institute's examinations is to test what the candidate can actually perform when he is placed as nearly as possible under the same conditions as he would be if working in his own laboratory and within reach of a good chemical library The candidate who shines in the one will not necessarily shine in the other examination The university graduate is more qualified to talk and to teach, but the overcrowding of his curriculum leaves him little time in which to practise and acquire technical skill, without which the institute's qualification cannot be attained It is Prof Frankland said in conclusion, this practical character which must be preserved in the institute's examinations, so that fellows and associates may be known for the soundness of their judgment and for their capacity to perform chemical work upon which the public can place implicit reliance

SOCIETIES AND ACADEMIES

LONDON

Faraday Society, February 19 —Dr T Martin Lowry in the chair —The present position and future prospects of the electrolytic alkali and bleach industry J B C **Kershaw** The paper opens with a brief historical review The second part of the paper contains a list of the works now operating in Europe and America summarising, so far as information is available, power used, type of cell and process employed, and products made The totals show that about 55,000 h p are now being devoted to the production of alkalies and bleach by the electrolytic method, and that plant representing about 13,000 h p is lying in reserve Assuming that all the plants are being worked to the best advantage, the production of 70 per cent caustic soda at present would be about 110,000 tons per annum, with an equivalent of 231,000 tons of 35 per cent bleaching powder (2 tons of caustic and 4 2 tons of bleach per E H P year) In conclusion, the future of the industry is discussed

Royal Meteorological Society, February 20 —Dr H R Mill, president, in the chair —Report on the phenological observations made during 1906 by observers in various parts of the British Isles E **Mawley** The most noteworthy features of the weather of the phenological year ending November, 1906, as affecting vegetation, were the dry period lasting from the beginning of June until the end of September, and the great heat and dryness of the air during the last few days in August and the first few days in September Wild plants came into flower in advance of their usual dates until about the middle of April, after which time they were, as a rule, to about the same extent late Such early spring immigrants as the swallow, cuckoo, and nightingale reached these islands somewhat behind their average dates The only deficient farm crop, taking the country as a whole, was that of hay, all the others being more or less above average The yield of apples was about average in all but the north of England and in Scotland, where there was a very scanty crop Pears and plums were everywhere very deficient, whereas all the small fruits yielded moderately well As regards the farm crops, the past year proved even a more bountiful one than that of 1905 —The metric system in meteorology R. **Inwards**. Attention was directed to the advisability of adopting some uniform system by all the meteorological observers upon the globe

CAMBRIDGE

Philosophical Society, January 28 —Dr. Hobson, president, in the chair —Kanalstrahlen in helium. Prof **Thomson**.—An experiment with a pair of Robison ball-ended magnets G F C. **Searle**. A Robison ball-ended magnet AB is supported on a pivot O close to a drawing board, and a second Robison magnet CD, resting on the board, deflects AB If p_{AC} denote the perpendicular from O upon AC, the turning moment experienced by AB is the resultant of the four moments $mm'p_{AC}/AC^2$, $mm'p_{AD}/AD^2$, $mm'p_{BC}/BC^2$, and $mm'p_{BD}/BD^2$, where m is the pole-strength of CD and m' that of AB. If h_A, h_B be the perpendiculars from A, B upon the line A_0B_0, where A_0, B_0 are the undeflected positions of A and B, the moment due to the earth's magnetic force, H, is $m'H(h_A+h_B)$ Equating these results the value of m is found in terms of H and of the four distances AC . and the six perpendiculars h_A, h_B, p_{AC} These ten lengths are measured on the drawing board —A method of determining the thermal conductivity of India-rubber G F C **Searle**. Steam from a boiler passes through an india-rubber tube, part of the tube being immersed in water contained in a calorimeter Since the conductivity of india-rubber (0 00042) is small compared with that of water (0 0013), the temperatures of the inner and outer walls of the tube may be taken as equal to θ_1 and θ_2, the temperatures of the steam and of the well-stirred water in the calorimeter The conductivity K is found from the rate of rise of temperature of the calorimeter by the equation

$$K = \frac{M}{2\pi l(\theta_1 - \theta_2)} \frac{d\theta_2}{dt} \log_e\left(\frac{a}{b}\right),$$

where M is the water equivalent of the calorimeter and its contents, a and b are the external and internal radii of the tube, and l is the length immersed —A curvature method for measuring surface tension C T R **Wilson**. To measure the surface tension of mercury, a circular hole of about 1 mm in diameter is made through a glass plate closing the upper end of a vertical tube The tube is filled with mercury and sufficient pressure is applied to give a suitable curvature to the meniscus projecting into the aperture The curvature is measured by making the meniscus serve as a convex mirror A microscope is focussed (1) on the centre of curvature (when a reflected image of the eye-piece cross-wires will be seen in focus), (2) on a fibre stretched just above the meniscus, (3) on the virtual image of the fibre formed by the meniscus From the vertical displacements of the microscope between these three positions the radius of curvature is obtained If the pressure be changed by a known amount between two such measurements of curvature the surface tension can be deduced —The application of integral equations to the determination of expansions in series of oscillating functions H **Bateman**.

February 11 —Mr D Sharp, vice-president, in the chair —The mode of formation of the initial cell-wall, the genesis and neogenesis of the connecting threads, and the method of connection of living tissue cells Dr W **Gardiner**. Having summarised the existing theories as to the structure of the "initial-wall" of plant cells, and the current view expressed by Strasburger as to the development of connecting threads, the author stated that his own observations appear to prove that the above views are inadmissible —The ethnology of modern Egypt Dr C S **Myers**. The measurements, notes, and photographs taken in this investigation lead to the conclusion (1) that, compared with the "prehistoric" people of 5000 B C, the modern inhabitants show no sensible difference in head measurements or in the degree of scatter of individual measurements about their average; (2) that the modern Copts throughout Egypt are less negroid than the modern Moslem population; (3) that both the Copts and the Moslems in Upper Egypt are more negroid than those in Lower Egypt, (4) that from the anthropometric standpoint there is no evidence of plurality of race in modern Egypt —Notes on the structure and behaviour of the larva of *Anopheles maculipennis* A D **Imms**. The paper dealt briefly with the occurrence of the larva of *Anopheles maculipennis* in the neighbourhood of Cambridge, together with notes on its bionomics.

EDINBURGH

Royal Society, February 4.—Dr R H Traquair in the chair —The fossil Osmundaceæ R **Kidston** and D. T. **Gwynne-Vaughan**. The paper contained a description of two new species of Osmundites, collected from the Jurassic of Otago, N Z, by Messrs Dunlop and Gibb, after whom they have been named *Osmundites Dunlopi* differs from the hitherto described species in possessing a continuous ring of xylem which is not interrupted by the departure of the leaf-traces In *O Gibbiana* the xylem ring resembles that of the recent Osmundaceæ, and is broken up into a large number of separate strands The structure of two other species, *O Dowkeri* and *O skidegatensis*, was also described and compared with that of the new species Their discussion of the bearing of the structure of the fossils upon the anatomy of the order led the authors to regard the osmundaceous stele as derived from an ancestral protostelic type with a solid central axis It was consequently suggested that the Osmundaceæ were derived from the same ancestral stock as the Botryopteridæ.—The development of the anterior mesoderm and paired fin, with their nerves, in Lepidosiren and Protopterus W E **Agar** The pro-otic mesoderm is quite unsegmented The material from which the eye muscles are derived is, however, drawn from an extended source, probably representing the three anterior somites of van Wighe A study of the conditions in these fishes lends support to the view of Gegenbaur as to the segmentation of the head in opposition to those of van Wighe It seems probable that the latter's fourth pro-otic somite represents a fused mass of segments to which the whole of the branchial region morphologically belongs An extension of splanchic head structures backwards in relation to trunk myotomes actually takes place in the ontology of these forms The constrictor muscle of the pharynx is derived from two distinct sources, one splanchic from the walls of the pericardio-peritoneal duct, the other somatic from the occipital myotome v A separation of the hypoglossal and brachial plexures is brought about by the greatly distended pronephros separating the ventral processes of those myotomes which supply the hypoglossal and pectoral fin musculature respectively The pectoral fin is situated in front of the myotomes which supply its mesoderm, and posterior myotomes are gradually ceasing to contribute to its development The pelvic fin develops at the hind end of its innervation region Its position is subject to considerable individual variation, but this is always accompanied by a corresponding variation in the position of the cloaca —Scottish Tardigrada, collected by the Lake Survey James **Murray** Though found in Scotland nearly 150 years ago, the Tardigrada were totally neglected until recently the Lake Survey offered an opportunity for their study In the paper a summary is given of all that is known about Scottish Tardigrada The list contains forty-one species In the Scottish lochs thirty-one species have been found Most of these are of casual occurrence in lochs only two or three species being normal inhabitants of water About twenty species were noted in the Shetland Islands, a fact of great interest being the occurrence of a number of species hitherto known only from Arctic regions A number of new species discovered had the same limited distribution being known as yet only from Scotland and Spitsbergen or Franz Josef Land Seven new species and four new varieties were described —Arctic Tardigrada, collected by W S Bruce James **Murray** Richters had already noted twenty-four species of Arctic Tardigrada. Bruce's collections on various expeditions yielded twenty-eight species, bringing the total number of known Arctic species up to forty Three new species were described, and there were eight which had been recently discovered in Scotland There were fourteen species common to Scotland and some part of the Arctic regions Of the twenty-two species collected in Spitsbergen, twelve were new for that region Franz Josef Land was virgin soil and of the nineteen species found there, fifteen occur in Spitsbergen.—*Prymnothonus Hookeri*, Poisson pelagique de *l'Erebus* et de la *Terror* retrouve par l'Expedition Antarctic Nationale Écossaise Louis **Dollo**. The fishes collected on the voyage of the *Erebus* and *Terror* were not all brought home in safety The most interesting of these lost fishes were the Prymnothonus and the Pagetodes The latter, which is probably the same as the Cryodraco of the Belgian expedition, was eaten by the cat of the *Terror* A figure of *Prymnothonus Hookeri* was copied from a sketch by Hooker and published in 1841 by Richardson, who considered it to be a Murænoid allied to the congers The figure is reproduced by Günther in the eighth volume of his catalogue of the fishes in the British Museum, and he follows Richardson in his description Later, in his "Pelagic Fishes of the *Challenger*" (1889), Günther places Richardson's specimen third in a series of four small fishes A, B C, D, and says —"I have no doubt that all these specimens represent larval conditions of fishes belonging to Paralepis or Sudis or of genera allied to them That they all are stages of development of the same generic type of fishes is very improbable but the second and third specimens may well be considered to be the same type, which provisionally may be designated by the name proposed for it by Richardson" M Dollo, on the other hand, does not consider the *Challenger* specimens A and B to have anything to do with Prymnothonus, and regards specimen D to be a mature specimen of Richardson's fish He gives a rectified diagnosis of *Prymnothonus Hookeri*, Richardson from three specimens collected by the Scottish Antarctic Expedition and places the fish in the family Paralepidæ, in accordance with Günther's indications

PARIS

Academy of Sciences, February 25 —M Henri Becquerel in the chair —The president announced the death of M Moissan, member of the section of chemistry and gave a short account of his life-work —Certain algebraical surfaces related to Abelian functions of the third kind L **Remy** —Remark on waves of shock Application to the explosive wave M **Jouguet** For a wave of shock to be propagated, it is necessary that it should have a velocity higher than, or at least equal to that of ordinary waves in the medium which precede it and lower than or at least equal to, that of the ordinary waves which follow it Admitting this proposition, the author applies it to the interpretation of the phenomena of the explosive wave —Some properties of the explosive wave M **Crussard.** —The influence of temperature on absorption in crystals. Magneto-optical phenomena at the temperature of liquid air Jean **Becquerel.** At the temperature of liquid air the optical properties of crystals approach the properties of transparent vapours, the absorption bands contracting forming a line spectrum The author's interpretation of these results is that the period of the proper movement of the electrons is not influenced by temperature in solid bodies, but that the damping or the resistance to the particles in vibration increases and decreases with the temperature The magneto optic phenomena exhibited by xenotime and tysonite at the temperature of liquid air have also been studied —The theory of the formation of aventurine copper glass A **Auger** Experiments tending to show that the colour is due to the presence of copper silicate —Ethyl lactyl lactate F **Jungfleisch** and M **Godchot** A study of the products formed by the action of heat on ethyl ($d+l$) lactate These are analogous to those obtained by heating lactic acid, but the mechanism appears to be different in the two cases —The atomic weights a function of the position which they occupy in the series of their increasing value Adolphe **Minet** —The melting points and boiling points of aliphatic and aromatic hydrocarbons Gustave **Hinrichs.** A discussion of a recent paper of M Tsakalotos —The coagulation of the latex of caoutchouc and the elastic properties of pure caoutchouc Victor **Henri** The latex of india-rubber is a negative emulsion, and its coagulation can be compared with the precipitation of negative colloids A study of the conditions of coagulation leads to the conclusions that the coagulation of the latex by electrolytes is determined by the positive ions of the electrolytes, the structure of the coagulum varies with the nature and concentration of the bodies employed for the coagulation a feeble coagulant producing a pulverulent or flocculent precipitate, an energetic coagulant an elastic clot with a reticular structure The elastic properties of the india-rubber obtained depend

greatly on the nature of the coagulant employed, there being a distinct relation between the fineness of the reticular structure of the clot and the elastic properties —The presence of phenylethyl alcohol in the essence from the needles of the Aleppo pine of Algeria Emilien **Grimal** Details are given of the method of extraction and identification of the phenylethyl alcohol —The successive distributions of terpenic compounds in various organs of the living plant Eug **Charabot** and G **Laloue** —Fluorine in the shells of molluscs P **Carles** The presence of fluorine in the mollusc shells is proved if the shell is treated with hydrochloric acid, the presence of fluorine may be easily overlooked, since hydrofluoric acid is carried away with the carbon dioxide —A new genus of Pennatulidae Ch **Gravier** —*Gardia alata*, a new species J **Kunstler** and Ch **Gineste.**—Some physico-biological conditions of Lake Mélah, Algeria J **Bounhiol** —The toxic effects of oysters J **Baylac** Apart from the possibility of bacterial infection, the fluid of the oyster itself possesses toxic effects and these are greatly increased by keeping at a temperature of about 16° C for two or three days The author is of opinion that many accidents attributed to the bacterial contamination of oysters are really due to the increase in the toxic power of the natural fluids of the oyster under the influence of temperature —Do elephants possess a pleural cavity? Mme Marie **Phisalix** A reply to a recent note of M Giard —New researches on the transplantation of nerve ganglia, transplantation in the frog G **Marinesco** and J **Minea.** In cold-blooded animals the transplanted ganglion cells live for a much longer time after transplantation, and react and repair their lesions more readily than the ganglion cells of animals at constant temperature —The distribution of microbial secretions in a culture, between the liquid of this culture and the micro-organisms Free toxins and adherent toxins Extra cellular bodies and intra-cellular bodies MM **Charrin** and **Goupil** —A remarkable case of an aneurism of the ophthalmic artery cured by gelatin MM **Lancereaux** and **Paulesco** In the treatment of aneurisms of the aorta by gelatin injection the improvement although marked, proves to be only temporary, and the effect of each injection is less than that of the one preceding, no permanent effect being produced In the case described the cure was complete and permanent after thirty-nine injections

DIARY OF SOCIETIES.

THURSDAY MARCH 7

ROYAL SOCIETY, at 4.30.—Experiments with Vacuum Gold Leaf Electroscopes on the Mechanical Temperature Effects in Rarefied Gases Dr J T Bottomley, F R S, and F A King —On the Resistance of Air A Mallock, F R S —Electric Furnace Reactions under High Gaseous Pressures R S Hutton and J E Petavel —On the Absorption of Water by Cotton and Wool Dr M W Travers, F R S

CHEMICAL SOCIETY, at 8.30 —The Constitution of Chaulmoogric and Hydnocarpic Acids M. Barrowcliff and F B Power —*Volume Changes which accompany Transformations in the System* $Na_2S_2O_3, 5H_2O$ *H M Dawson and C G Jackson*

AERONAUTICAL SOCIETY, at 8 —Wings *v* Screws Colonel J D Fullerton, R E —The Free Lever in the Flying Machine Herr Karl Milla.—Theory of Sailing Flight José Weiss

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —The Transmission of Electrical Energy by Direct Current on the Series System J S Highfield

LINNEAN SOCIETY, at 8 —On the Development of the Frog Miss N F Layard —Biscayan Plankton, Decapoda S B Kemp —A Special Point in the Colour Adjustment of Chamæleon Prof E B Poulton, F R S —New Channel Island Plants G Claridge Druce —*Exhibitions:* Specimens of *Nitella ornithopoda*, A Br H and J *Groves* —(1) *Probate of the Will of Richard Anthony Salisbury*, (2) Manuscripts of Dr W J *Burchell Prof E B Poulton F R S*

CIVIL AND MECHANICAL ENGINEERS SOCIETY, at 8 —Types of Enclosed Steam Water Heaters C R. Allensby

FRIDAY, MARCH 8

ROYAL INSTITUTION, at 9 —Certain Seasonal Diseases of the Sheep, and the Means of Preventing Them Prof D J. Hamilton

PHYSICAL SOCIETY, at 8 —The Rate of Recovery of Residual Charge in Electric Condensers Prof Trouton and Mr Russ.—Experimental Mathematics: Mr Pichon.—An Instrument to describe Families of Equiangular Spirals Mr Blakesley —A *Micromanometer* Mr Roberts

INSTITUTION OF CIVIL ENGINEERS, at 8 —Corrugations on Tram-Rails A. T Arnall.

MALACOLOGICAL SOCIETY, at 8 —On the Non Marine Mollusca of the Mylne Collection A S Kennard and B B Woodward —Notes on Holocene Mollusca from Ightham A S Kennard and B B Woodward.—Descriptions of Four New Species of Melania from New Ireland and Ke-lan-tan H B Preston —On the Arms of the Belemnite: G C Crick

ROYAL ASTRONOMICAL SOCIETY, at 5 —Computation of Secular Perturbations R. T A. Innes.—Observations of Occultations: Rev. A. L. Williams —Baxendell's Observations of U Geminorum: Edited by H. H Turner —On the Classification of Long-period Variable Stars, and a Possible Physical Interpretation H. H. Turner.—Perturbations of Halley's Comet P H Cowell and A C D Crommelin.

SATURDAY, MARCH 9.

ROYAL INSTITUTION, at 3 —Röntgen, Kathode, and Positive Rays: Prof. J J Thomson, F R S

MONDAY, MARCH 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in Turkey-in-Asia: Mark Sykes.

TUESDAY, MARCH 12.

ROYAL INSTITUTION, at 3 —The Visual Apparatus of Man and Animals. Prof William Stirling

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of Overhead Electric Transmission lines A P Trotter.

WEDNESDAY, MARCH 13

SOCIETY OF ARTS, at 8 —Mediæval Stained Glass, its Production and Decay Noel Heaton.

GEOLOGICAL SOCIETY, at 8 —A Silurian Inlier in the Eastern Mendips Prof Sidney H Reynolds —On Changes of Physical Constants which take place in certain Minerals and Igneous Rocks, on the Passage from the Crystalline to the Glassy State, with a short Note on Eutectic Mixtures J A. Douglas.

THURSDAY, MARCH 14.

ROYAL SOCIETY, at 4.30 —*Probable Papers*:—On the Gravitational Stability of the Earth Prof A E H Love, F R S.—The Total Ionisation of Various Gases by the α Rays of Uranium T H. Laby —On the Ionisation of Various Gases by the α, β and γ Rays R. D. Kleeman.

ROYAL INSTITUTION, at 3 —Biology and Progress Dr C. W Saleeby.

SOCIETY OF ARTS, at 4.30 —The City of Madras Sir James Thomson

MATHEMATICAL SOCIETY, at 5.30.—Exhibition of a New Calculating Machine C W Evans Cross —On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of Indeterminate Equations of the Second Degree Dr T Stuart —Invariants of the General Quadratic Form *Modulo* 2 Prof L. E Dickson

INSTITUTION OF ELECTRICAL ENGINEERS, at 8 —*Adjourned discussion* The Transmission of Electrical Energy by Direct Current on the Series System J S Highfield

CONTENTS.

THURSDAY, MARCH 14, 1907

MODERN MOTOR VEHICLES

Motor Vehicles and Motors their Design, Construction and Working by Steam, Oil and Electricity By W. Worby Beaumont Vol ii Pp xvi+677. (London Archibald Constable and Co., Ltd, 1906) Price 42s. net

WHEN we reviewed the first volume of this work on the motor vehicle, we pointed out how difficult it is adequately to review encyclopædic matter, which in this instance occupies 660 pages of letterpress, accompanied by upwards of 400 illustrations Mr. Beaumont has, in this second volume, supplied many of the omissions and corrected some of the mistakes which existed in his first volume, so that now the two volumes, taken together, form a valuable work of reference, not only for the general public interested in the motor movement, but of considerable value to professional engineers

In this second instalment, after a short introduction pointing out the rapid development of motor engineering during the last two years, Mr Beaumont devotes the first half of the work to descriptive matter dealing with motor vehicles of all kinds commencing with the lighter motor-cars and going on to the heavier vehicles and electrically-propelled cars We do not propose to say much on this portion of the book No doubt those who are interested in any particular make of car will turn to the description of that car, but to the general reader the whole of this portion of the work savours of a dealers' catalogue, and is somewhat wearisome to read The few pages dealing with modern American vehicles show that these vehicles are interesting, as they depart rather more widely from the conventional types than is the case with the Continental and British-made cars

With chapter xxi the really interesting part of the book commences In this and the following chapters the author summarises the advances that have been made in the design and in the various components which are now accepted as the necessary features of a petrol-driven vehicle In chapter xxiii he gives us in a compendious form his methods of computing the h p absorbed in propelling motor vehicles, but we notice that on p 349 he repeats the coefficient for air resistance which he originally gave on p 49 of the first volume, namely, that the total air resistance of a vehicle varies as the velocity squared in miles per hour multiplied by the exposed cross-section of the car, multiplied by the coefficient 0.0017 It must be noted that this coefficient is only about two-thirds of the value of that which was obtained after careful experimental work at the National Physical Laboratory by Dr Stanton as that of flat-fronted solid bodies moving through columns of air the cross-section of which is very large in relation to the solid body that moves through them We think that although Mr Beaumont explains this low figure by the fact that it works in very fairly with his computations as to the actual h p exerted by cars of all classes, both in hill-climbing competitions and on speed trials up to 60 miles an hour it must be admitted that far more accurate experimental measurements must be made to ascertain whether this extremely low figure of 0.0017 has ever been approached by any form of solid moving through a column of air even in cases where great attention has been paid to the form of the solid, especially to the stern lines, to use nautical nomenclature It appears probable, therefore, that the table vi on p 350 is likely to need considerable correction

The author in chapter xxiv gives us very valuable and interesting notes on the influence of the vibration and even turning effort of the propelling engine on the stability of the car when it is driven rapidly round sharp bends of the road We think that in this chapter he is substantially correct in his views, and the matter is of great importance, and has hitherto not received sufficient attention from the designers of these vehicles

With chapter xxv he commences his descriptions of the heavier class of modern self propelled vehicles applied to commercial purposes such as the carriage of goods, omnibuses and other public-service passenger vehicles This part of the descriptive matter is very full, but from the nature of the subject is incomplete, as in no branch of the industry have there recently occurred such great changes, and these changes are likely to continue to occur as the type of public-service vehicle is yet very far from perfect, and is likely to be greatly modified in the immediate future, in fact, it is not too much to say that most of the vehicles described in chapters xxv to xxviii will be obsolete in a few years time, particularly when we consider the extraordinary results which are now expected from the adaptation to these vehicles of highly superheated steam produced in flash or semi-flash boilers, for although in chapters xxix to xxxi the author gives descriptions of the various forms of steam-driven cars made by Serpollet White, Turner-Miesse and Clarkson, and others, these really relate to the smaller class of pleasure car, and not to the public-service vehicle

Chapter xxxii which deals with the highly important and dangerous question of the skidding of self-propelled vehicles on our greasy streets, is disappointing, as the author gives no indication of the direction in which improvement is to be expected He does not even touch on the highly interesting matter of how much depends on the skill of the drivers and of the power rapidly acquired by them of controlling the side slip or skidding by a certain rapidity of action and correlation of hand and eye correcting the tendency to skid at the earliest stage, long before the brain has had time to consider the matter and to apply a corrective effort

The chapter devoted to carburetters is interesting as it shows that much ingenuity has been applied to this most important organ of the internal combustion engine, yet little or nothing has been done on the question of the day, namely, the utilisation of the heavier oils for these engines Until this is done

everyone who uses the petrol-driven motor-car is at the mercy of the kings of oil finance, who at present are masters of the situation

Another important matter, that of electrical motor vehicles, is dismissed in a single chapter, although, on account of the recent reductions in the cost of electrical energy the prospects of this class of vehicle are increasingly good

In the chapter devoted to the consideration of the efficiency of transmission gear, the matter is dealt with in an ingenious manner, and it is probable that the rough-and-ready method adopted by the author of calculating the transmission losses is within a narrow percentage of being correct The objects of the tourist trophy race initiated by the Automobile Club are clearly explained, and the cars taking part in the first of these races are tabulated and their performances usefully compared

Altogether, the author, in this second volume, has been very reasonably successful in dealing with the difficult task of getting together sufficient descriptive matter to satisfy any reasonable inquirer, and has made his matter as short as was possible considering that he has been compelled to describe a mass of vehicles the bulk of which resemble one another very closely, as most of the designers have copied the main features of two or three Continental models, and only vary in certain details or special methods of cheapening or facilitating manufacture

THE SOLAR RESEARCH UNION

Transactions of the International Union for Co-operation in Solar Research Vol i (First and Second Conferences) Pp 257 (Manchester University Press 1906) Price 7s 6d net

In a previous number of this Journal a brief summary was given of the proceedings of this International Union at its second conference, held at Oxford in September, 1905 The volume before us gives a complete historical account of the union from its origin in 1904 up to the end of the work completed at the Oxford meeting, and its appearance is due to the energy of the chairman, Prof Schuster who has brought all this useful material under one cover

The subject is dealt with under seven heads The first shows that the origin of this union was due to Prof George E Hale, who issued a circular letter to a number of men of science interested in solar physics The receipt of favourable answers led him to approach various societies and academies, with the result that a meeting was arranged and held in connection with the International Congress of Science at the St Louis Exhibition

Part ii deals with the proceedings of the first conference, which took place in September, 1904, and is followed by part iii, which contains *in extenso* the papers submitted to the conference They include introductory remarks by Prof Hale on the importance of international cooperation in solar research, and valuable reports by Henry Crew, A Pérot, C Fabry, H Kayser, and Lewis Jewell on the importance of establishing a new system of standard wave-lengths

In part iv we are made acquainted with the preparations for the second conference. A portion of this consisted in sending out circular letters to members of the union and others, relative to such subjects as the fixing of standards of wave-length, measurement of the intensity of solar radiation, work done with the spectroheliograph, and the spectra of sun-spots In response to these, numerous valuable replies were received, and these are all included in the volume

At the Oxford conference some important papers were communicated (part vi), among which may be mentioned the compensating pyrheliometer, by K Ångstrom At this conference the constitution of the union also was discussed, and we have in this volume (part viii) the text in English, French, and German of the constitution as finally adopted, and the resolutions, also in the three languages, concerning the various important questions discussed

An important result of the Oxford conference was the appointment of committees to take in hand the work of preparation and organisation of investigations which have not yet been collected and co-ordinated

In connection with these, the present volume contains a very valuable memoir, drawn up by Prof Fowler, on the observations of the spectra of sun-spots in the region *b* to F (part vii) This paper brings together in a very admirable manner the main features of the spectrum-analysis of sun-spots, and will serve as a valuable guide to those observers who take up this part of solar physics

The next meeting of the union will take place at Meudon in May of the present year There is every probability, therefore, that a second volume of these transactions will make its appearance during the next twelve months

AGRICULTURAL ANALYSIS

The Principles and Practice of Agricultural Analysis By Dr H W Wiley Vol i Soils Second edition, revised and enlarged Pp xii+636 (Easton, Pa Chemical Publishing Co, London Williams and Norgate) Price 18s net

Dr WILEY'S treatise on agricultural analysis has long been the chief resource of every worker in that domain, because it contained not merely the particular method in vogue, but to a large degree all the methods that had been proposed or were in use in either American or Continental laboratories, very often in the words of the original This did not make the book easy to use by the tyro, for Dr Wiley rarely attempted any criticism or recommended one method beyond another, but the collection was extremely useful to the investigator, and saved him much labour in trying over things which had been tested before The gain is particularly apparent in dealing with soils, the subject of the present volume, for the analysis of a soil is not like that of a manure, where there is a definite element or elements to be

determined and a result in sight the correctness of which is only limited by the imperfections of the method. Instead, the methods are often conventional, depending upon such factors as the method of preparing the sample or the solvent employed, or they may be determinations like the absorptive power of the soil for water, which have no absolute meaning at all, but are merely attempts in the laboratory to get a number which shall represent the behaviour of the soil in the field. With regard to so many of these determinations of a physical nature the difficulty lies, not in carrying out the process, but in interpreting it afterwards, and correlating it with some practical aspect of the soil. The present volume of Dr. Wiley's book becomes in consequence, something more than a collection of analytical methods, it is in many respects a treatise on soil chemistry and soil physics, so full are the introductory discussions dealing with each of the various means of investigating the soil, and as such it is indispensable to all serious students of agricultural chemistry.

Dr. Wiley has cut out some of the matter of the earlier edition, though retaining processes which have a historical interest or are necessary in tracing the development of the more modern method, he has further incorporated methods and investigations which have been published in the twelve years that have elapsed since the appearance of the first edition. The present volume is dated October, 1906, we miss, however, one or two methods which appeared before that date, *e.g.* Mitscherlich's interesting determination of the heat evolved when a soil is moistened (benetzungswärme), which is correlated with the active surface of the soil particles. In one or two other respects also we think later work might have modified some of the conclusions expressed, but of course the subject is in a constant state of progress, and the time occupied in writing a book of this magnitude is sufficient to bring about a revision of some of the points of view. We notice, indeed, but scant reference to the more recent developments in soil investigation which have issued from the Division of Soils in the United States Department of Agriculture, perhaps we may take this negative attitude of Dr. Wiley's as a critical one.

In conclusion, we can only express our thanks for what must always be one of the most useful books in the library of any agricultural laboratory.

A. D. H.

OUR BOOK SHELF

Introduction to the Theory of Fourier's Series and Integrals and the Mathematical Theory of the Conduction of Heat. By H. S. Carslaw. Pp. xvii+434. (London: Macmillan and Co., Ltd.) Price 14s. net.

THIS book is an interesting sign of the times. The gulf between pure and applied mathematics, in this country at any rate, has of recent years become more and more complete. Indeed there is no one who so heartily detests and despises mathematics proper as the ordinary physicist. He is often compelled to use elaborate mathematical analysis, but he does not feel or profess any interest in anything but the result, and questions as to the mathematical basis of his arguments seem to him merely trifling and vexatious.

Prof. Carslaw has therefore shown a good deal of courage in offering to English readers a book on the theory of conduction of heat which includes a serious account of the mathematical difficulties of the theory and may expose him to unsympathetic criticism from different points of view which have little in common. However, the experiment is a distinct success, and it is to be hoped that it will lead to similar and equally successful experiments with other and more difficult branches of mathematical physics.

The book is divided into two parts. Part i. is entirely mathematical, and it is this part which contains most that is novel in an English book, and is, therefore, most interesting to the critic. A short but well-written historical introduction is an attractive feature. In the first two chapters, which deal with irrational numbers and infinite sequences in general, the author mostly follows Dedekind and Tannery, and he could not have chosen better guides. The chapters on uniform convergence are also good, though here the arrangement and method of presentation do not seem to us in every respect the best. The author, we are glad to see, speaks of "*infinite* definite integrals" and discards the barbarous "improper." He might perhaps have brought out more clearly the fact that the infinite integral is essentially a repeated limit—as it is, he rather exaggerates the analogy between the integral and the infinite series, and it is a pity that he should have omitted to prove the fundamental inversion theorems for finite integrals. But the chapters dealing especially with Fourier's series seem to us the best; we are particularly glad to see Fejér's theorem included. Part ii. contains a clear account of the principal problems of conduction, and requires no special comment here.

This book shows very clearly how much of the Continental spirit of rigour English mathematics has absorbed in recent years. It also shows how much the heaviness of the Continental δ and ϵ can be lightened by a bright and attractive style, interesting illustrations, numerous examples, and other touches of the Cambridge tradition.

G. H. H.

Museu Paraense de Historia e Ethnographia. Arboretum Amazonicum. By Dr. J. Huber. Pp. 40, with 40 plates. Decades i. to iv. (Para, 1900 and 1906.)

FOR a development of moist equatorial vegetation no region surpasses that bordering the Amazon and its tributaries, which Dr. Huber, in the course of his long association with Para, has had unique opportunities of visiting. The form in which Dr. Huber presents his information is similar to the "Vegetationsbilder," where the illustrations are the chief feature and the notes are explanatory thereto, but it should be stated that the first two parts of the "Arboretum Amazonicum" were issued in 1900, previous to the first numbers of the "Vegetationsbilder." Two additional parts appeared last year, and it is proposed to complete the work in ten numbers. The publication of the work has been undertaken by the Polygraphisches Institut of Zurich, and the photogravures afford a criterion of the excellence of their work.

Palms generally rank among the most important tropical plants, and along the Amazon and its tributaries, especially near the embouchure, they form such prominent objects in the landscape that all voyagers make special mention of their luxuriance and variety. Dr. Huber devotes a number of plates to different species: *Phytelephas microcarpa*, that yields vegetable ivory, the Tucuma and Mumbaca palms, both species of Astrocaryum, the Javary, another species of the same genus, bearing spines on the young trunks, and the Bussu, *Manicaria saccifera*, producing huge, almost entire, leaves, are illustrated in the first two parts. No less interesting are *Cocos inajas*, with pinnæ arranged in bundles on the leaves, the Baccaba or wine-palm, *Oenocarpus distichus*, remarkable for the distichous arrangement of the leaves, and the Urucury, *Attalea excelsa*, which provides the *Seringueiro*, or rubber collector, with nuts used in smoking the rubber. Of trees other than palms, the famous Para rubber tree, *Hevea brasiliensis*, *Dipteryx odorata*, the source of the Tonca bean of commerce, *Bertholletia excelsa*, the superb tree yielding brazil-nuts, and the magnificent *Caryocar villosum* are selected for representation.

Dr. Huber has also chosen some illustrations of typical plant formations, including the littoral vegetation on the river Couany, where the Aninga, *Montrichardia aborescens* is growing on the shore, scenes from some of the tidal creeks or channels known as "igarapés", plant formations occurring in inundated localities, showing in one case a fine development of *Ipomoea fistulosa*, in another a wide expanse of *Panicum amplexicaule*, and a view of an Indian plantation with manioc and sugar-cane in the foreground, and the characteristic Imbauba, *Cecropia peltata*, beyond.

The illustrations are admirable, owing to the care that has been exercised in selecting fine specimens and suitable situations from which the characteristic features of the plants can be brought into the photographs.

Cams, and the Principles of their Construction. By George Jepson. Pp. 60. (New York: D. van Nostrand Co.) Price 8s. net.

IN this work examples are given of the design of cams of various types, including cylindrical, conical, face and spherical cams, and of different degrees of complexity from the simple heart-shaped cam employed in winding bobbins to the writing cam with the differential motions of paper and style. The illustrative drawings are accurately and beautifully executed, the construction lines being printed in red ink for the sake of extra clearness. It is shown how to design the profile of a cam so as to give a simple harmonic motion or a uniform acceleration and retardation to the follower, thereby effecting a change of position of the latter with a minimum wear and tear. The book is a welcome addition to the somewhat scanty literature on the subject.

Rivetage. By M. Fricker. Pp. 168. (Paris: Gauthier-Villars and Masson et Cie., n.d.)

THIS little volume belongs to the "Encyclopédie scientifique des Aide-mémoire" series, to which attention has often been directed in these columns. It is divided into two parts, the first passes in review the rules—for the most part empirical—which are adopted in determining the dimensions of rivets and in riveting generally, and the second describes the methods which are employed in the actual processes of riveting.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Mud Volcano Island.

ADMIRAL FIELD'S letter in NATURE of February 28, embodying Commander Beauchamp's description of a new island recently discovered by him about nine miles northwest of Cheduba (not Chebuda) Island, off the coast of Arakan, leaves no room for doubt that the island in question was due to the eruption of a submarine mud volcano.

Ramri and Cheduba, together with the adjacent subordinate islands, are composed mainly of shale and sandstone (probably of Tertiary age), containing some coal, and also very considerable quantities of petroleum, accompanied by inflammable gas. There is evidence of a certain degree of abnormal subterranean heat, although such is far lower than that associated with true volcanoes, which do not exist, nor have any volcanic rocks been observed. Mud volcanoes are fairly numerous, which, besides emissions of a quieter character, are subject, at uncertain intervals, to violent paroxysmal eruptions. At such times mud and stones are shot out with great force and noise, accompanied by large quantities of inflammable gas, which in many cases catches fire and gives rise to a volume of flame that lights up the country for miles around. There are numerous well authenticated descriptions of such occurrences, more than one of which were submarine. The stones ejected are all derived from the stratified rocks mentioned above, the shales furnishing the source of the mud. Electric sparks produced by the friction of the ejecta amongst themselves probably cause the ignition of the gas. Some of the recorded paroxysms were synchronous with earthquakes.

A somewhat detailed account of the mud volcanoes may be found in the "Records of the Geological Survey of India," vol. xi. (1878), pp. 188–207, and descriptions of several later eruptions in subsequent volumes.

Ealing. F. R. MALLET.

A New Chemical Test for Strength in Wheat.

THE principle of the test for strength in wheat flour described as new by Mr. T. B. Wood in a recent issue of NATURE (February 21), and further claimed by Dr. E. Frankland Armstrong (NATURE, March 7) as having been in regular use in his laboratory during the past year, was employed by me more than four years ago, and still forms an important factor in my physicochemical method of gauging the baking qualities of wheat flour.

I can fully corroborate Mr. Wood's opinion that no single factor is capable of measuring the strength value of wheat, and Dr. Armstrong's statement that the problem is one in which no small number of variables must be dealt with.

In 1905 Mr. A. E. Humphries supplied me with five samples as tests of the accuracy of my system as then elaborated. I was, however, not successful, but, on receiving Mr. Humphries' views of their baking qualities, the cause of my failure was at once apparent. When investigating the relation of chemical composition to baking qualities I had relied for the latter data upon loaves baked in tins, whilst Mr. Humphries based his opinions upon self-supporting loaves of the "cottage" type. It thus became evident that it was necessary to view the analytical data from a standpoint suited to a definite system or method of baking. That different systems of baking require different types of flour explains why millers occasionally receive both commendatory and condemnatory remarks from their customers on the quality of the same blend of flours.

I hope soon to have an opportunity of publishing some of the results of my investigations of the correlated factors determining the blending qualities, strength, and texture properties of wheat flour.

After a very lengthy investigation of the biochemical changes which occur in the natural ripening of the wheat berry, its preparation or "conditioning" in the mill, and the influence of variations in the treatment of the resulting flour in the bakehouse, I am fully convinced that it is no longer the bakehouse that has to give the final verdict on the qualities of flour, as laboratory methods can now provide all the data necessary for inferring the antecedent conditions, defining the present qualities, and anticipating the future evolution of wheat or its product flour

A J BANKS

Waterloo, Liverpool, March 11

Ionisation and Anomalous Dispersion

IN NATURE of February 21 Prof Wood, referring to my letter of January 17, says that the effects observed were probably due to disturbance of the density gradient of the sodium vapour caused by "local heating by the wire" I am afraid that in my letter I cannot have described the experimental arrangement sufficiently clearly, at any rate Prof Wood seems to be under a mistaken impression

The wire was merely an electrode insulated from the tube containing the sodium vapour, but connected to one pole of a battery, the other being connected to the tube A current passed through the sodium vapour, or the nitrogen left in the tube after exhaustion and heating, presumably an ionisation current and this was of the order of one microampere, and could hardly produce much local heating

Be this as it may since I left Aberystwyth my pupil Mr Needham noticed an effect which if confirmed, appears to me to be decisive in favour of a connection between ionisation and dispersion While the tube was heated, by a flame as usual with 10 volts there was a current of 4 divisions and an anomalous dispersion of 9 divisions On raising the voltage to 58 volts the current rose to 10 divisions but the *anomalous dispersion immediately fell to zero* and thereafter slowly increased to a value somewhat greater than before

That an increase of current and presumably of local heating if there be any should diminish the dispersion temporarily can hardly be understood unless the systems producing the dispersion are themselves electrically charged and swept away to the electrode I hope shortly to investigate the whole question fully so as to decide definitely what connection, if any, exists between ionisation and dispersion

G A SCHOTT

Physical Institute Bonn February 26

The Rusting of Iron

IN NATURE of February 21 (p 390) Prof W R Dunstan states that rusting of iron takes place in the presence of water and oxygen when every trace of carbonic acid has been removed To a certain extent this is the result obtained by our chemist but his experiments proved conclusively that rusting must be due to an admixture of carbonic acid for with improved precautions against its presence rusting was enormously reduced, and this is important, confined to one or two spots In some cases this local rusting took place where the steel samples rested on the glass vessels and it was but natural to suppose that this local corrosion was brought about by silicic acid of the glass The obvious precaution was to arrange an iron bowl in the centre of the glass vessel into which water could be distilled, but although this apparatus was constructed, it was not used because if corrosion can be caused by the silica of the glass, then it may also be caused by specks of exposed slag in the iron or by the oxidised specks of manganese sulphide which can be seen with the microscope or by other impurities Corrosion may even be brought about by carbonic acid occluded in the iron In order to settle the question the experiment should be repeated with a piece of iron of absolute purity

C F STROMEYER

Manchester, March 5

A Problem in Chance

THE law of probability is often illustrated by the simple method of supposing a bag filled with an equal number of white and black balls which are presumably uniformly distributed within the bag It is stated that the chances are equal that any extracted ball will be black or white

I am desirous of ascertaining how this equality of extraction of either colour would be disturbed if it be assumed that the balls are not merely inert, but that there is an inherent tendency for like-coloured balls to cluster together Two subsidiary and mutually alternative conditions may be further assumed either the tendency of the black balls to cluster together is greater than that existing between the white balls or it is equal It is the former of these two subsidiary conditions that interests me

Perhaps I may state the problem in more definite form Assume 2000 balls, of which half shall be black and half white placed in a bag The intensity with which the latter tend to cluster = d and that of the former is greater, but to a less degree than half as much again The balls are extracted in groups of eight In four separate extractions what will be the probable proportion of black and white balls at each extraction? And how many extractions will have to be made before it is probable that an equal number of black and white balls will have been withdrawn?

GEO P MUDGE

London Hospital Medical College

THE UNIVERSITY OF THE CAPE OF GOOD HOPE

ON the invitation of Sir Lauder Brunton a meeting took place at his residence on January 21 of gentlemen interested in university education Among those present were Sir Arthur Rucker (of the London University) Dr Donald MacAlister (then of Cambridge University and president of the General Medical Council), Prof Perry (Royal College of Science) Sir W Arbuckle (Agent-General of Natal) Sir David Gill Sir John Buchanan and Mr Howard d'Egville honorary secretary Imperial Federation (Defence) Committee Prof Osler (of Oxford University), Sir Norman Lockyer K C B Sir Thomas Fuller (Agent General for Cape Colony) and Prof Stirling dean of the medical faculty of the Victoria University, were unfortunately prevented from attending Copies of the proposals provisionally agreed to by the committee of University of the Cape of Good Hope, relative to the re-organisation of that University had been circulated before the meeting and formed the basis of the evening's discussion The result was a consensus of opinion on several leading issues which may be summarised as under

(1) That in the existing condition of South Africa the interests of the higher education of the country would best be served by the continuance of only one examining and degree-conferring university

(2) That the conferring on single colleges in the country the power of granting degrees to their own students would be detrimental to higher education and specially injurious to the status of all such South African graduates Such degrees would be depreciated, not only in the estimation of the people of the country itself, but also outside the colony, and would not have the same value or consideration given them which degrees granted by one general University would receive The tendency of multiplying degree-granting institutions in the circumstances such as those existing in South Africa would be in the direction of unhealthy competition which would inevitably lower and not raise the worth of degrees so obtained

(3) That sound education would be promoted by associating in examinations the teacher with independent examiners, but the University should control all

examinations, and alone determine the granting of degrees. The appointment of examiners outside the influence of local institutions is desirable, so as to secure confidence in the impartiality of the examination, examiners of experience in teaching the subjects in which they examine should be employed. Efficiency, as well as confidence, would further be secured by obtaining as presiding members of each board of studies examiners experienced in teaching in institutions in the older centres of education.

(4) That all colleges should be affiliated with the University, and should be directly represented on the University council, if necessary larger representation being given to the larger institutions.

(5) That in any new Act of Incorporation or new charter provision should be made so as to leave the University free to expand, and to include new teaching bodies, as well as to develop in any direction in which the progress and prosperity of the country might in the future indicate.

AN ANTHROPOLOGIST AMONG THE TODAS.[1]

DR. RIVERS has re-discovered the Todas. This curious little nation, long known to us as an isolated social abnormality, in which the dairy industry takes the place of religion and matrimonial safety is found in a plurality of husbands, now appears to be both much more and much less than this. As a descriptive monograph in ethnology the book is a remarkable achievement, but it is, perhaps, most significant on account of its method. The social sciences are at a disadvantage in that they are not exact, as physical and mathematical sciences are exact, but the present work is a proof that anthropology is attaining such exactness as the nature of the subject allows. This means a good deal, as anyone may see who compares the present monograph with the earlier accounts of the Todas. The testing of the evidence and the verification of fact have been carried out in the most pertinacious and patient manner, and the general method followed is new enough in its application to deserve the epithet original. To the superficial reader little trace of this laborious preliminary process may be revealed, but the work will justify itself by remaining unsuperseded. It struck me as interesting that the account is compiled in such a way as to show itself in the making, that it is an organism, revealing its own evolution.

The Todas are sufficiently isolated as to render the problem of their origin more or less insoluble. Dr. Rivers makes a very good case, of the cumulative sort, for their *provenance* from the Malabar races. There are some interesting clues leading us back to the Christianising of South India more than a thousand years ago.

In their social organisation, the new facts collected by Dr. Rivers make our knowledge of the Todas practically free from lacunæ. To the comparative student this very full and detailed account will serve, among other things, to connect the sociology of India with that of the rest of mankind. The polyandrous character of marriage, and the customs of *terersthi* and the like, deserve studying in these pages by anyone who takes an interest in the marriage problems of Western civilisation. The Toda view of morality in this sphere merits consideration, especially in connection with the altruistic emotions. Something similar has been recently observed by Messrs. Spencer and Gillen among the natives of Central Australia. Not least remarkable is the way in which their form of marriage seems actually to make for efficiency and righteousness.

The chief regulations of the marriage system are in brief:—Prohibition of intermarriage between the two "castes" *Tartharol* and *Teivaliol*, exogamy among the clans which compose these "castes", certain kinship prohibitions, polyandry the typical form of marital association, the extra husbands being generally brothers of the husband proper, polygyny now on the increase either in the ordinary form, or two men having two wives in common, the transference of wives from one group of husbands to another, *terersthi*, a sort of concubinage, as between members of the two great "castes," *mokhthoditi*.

Fig. 1.—The 'Palikartmokh' saluting the threshold of the dairy at Kiudr 'Pavnersatiti'. From "The Todas."

We are supplied with a wealth of detail, practically new, in all the spheres of social life and religious practice. The economic sources of religion are more clearly laid bare in the full description of the dairy-religion of the Todas than would have ever appeared possible to the *a priori* speculator in anthropological theory. To quote Dr. Rivers:—"The sacred animals are attended by men especially set apart who form the Toda priesthood, and the milk of the sacred animals is churned in dairies which may be regarded as the Toda temples, and are so regarded by the people themselves. The ordinary operations of the dairy have become a religious ritual, and ceremonies of a religious character accompany nearly every important incident in the lives of the buffaloes." It would be a pity to attempt to skim the cream from the rich supply presented here; the reader will find it deeply interesting, and the student of religious origins will be well advised to ponder the whole subject. The best photographs in a well-illustrated book represent the operations of these milkmen, priests and

[1] "The Todas." By W. H. R. Rivers, Fellow of St. John's College, Cambridge. Pp. xviii+755; with illustrations and tables. (London: Macmillan and Co., Ltd., 1906.) Price 21s. net.

acolytes, the shrines and the divinity thereto attached It is interesting to note that the people would talk about an important ti "in exactly the same kind of way that an Englishman talks about a benefice "

FIG 2—Toda man From "The Todas"

The European cleric and the Toda *palol* thus meet after a journey commenced at what widely separated points Thanks to Dr Rivers's energy and care we have a complete and scientific account of one of the most significant phenomena in the history of that varied organism, religion

The author is of opinion that the division of the people into *Teivaliol* and *Tartharol* is due to the coalescence of two tribes, coming to the hills at different times There are marked dialectical differences between them The Toda language as a whole is very difficult The philologist will find it well worth study, and the data are both extensive and rendered more valuable in a way because the collector was himself ignorant of any other Dravidian tongue, and had therefore no expert prejudices The secret and sacred languages are rather conspicuous in the life of the Todas

The book—Dr Rivers' first book, if I mistake not, in this subject—is a monument of industry and care, not without insight and the results of comparative study, and is an invaluable record of which Cambridge and the new anthropology may be proud

A E CRAWLEY

A LAW OF RECORD TIMES IN RACING

A REMARKABLE article on "An Approximate Law of Fatigue in the Speeds of Racing Animals," by Mr A E Kennelly, appears in the Proceedings of the American Academy (vol xlii , p 275) for December, 1906 We cannot help speculating as to the causes which led the author to choose such a subject for investigation To the man of science, even to the omnivorous statistician, the subject sounds so unpromising—one may almost say undignified or improper, the sort of subject with which no civil servant, no permanent official, should ever deal, even in secret Once the investigation was commenced, it was naturally extended from one series of records to another, but what accident prompted the commencement? Mr Kennelly is provokingly silent on the point He opens, it is true, by telling us that "Olympia and Epsom Downs are known to fame by the races they have witnessed Olympian races, recently revived, are of international interest

A reduction of either of the records [for the 100 yards or the mile] by even one per cent would be a matter of world-wide importance, and the hero of the new record would be famous among the inhabitants of the temperate zones " Yet we find it hard to believe that the investigation was undertaken simply as a definite matter of urgent public importance, even though the results, as it turns out, may have the gravest social consequences They may lead to the advertising of mathematical tables and squared paper in the sporting press They may even influence the teaching of mathematics in our public schools, our universities, and other haunts of ancient peace

Put briefly and in its simplest possible form the approximate law relating distances with record times which Mr Kennelly has discovered is as follows —For all pairs of distances in the same proportion the record times are in constant ratio and this ratio is independent of the animal and of the mode of progression The observed ratios fluctuate, as one might expect, but the fluctuation seems to be of a casual kind over a very wide range of distances, and the ratios for different animals or modes of progress show little more divergence than the ratios for the same animal and the same mode of progress Thus, taking merely a few instances in the ratio 2 1, we have —

HORSES TROTTING

Distance (miles)	Time (seconds)	Ratio of times
1	118 5	—
2	257 0	2 16
4	598 0	2 33
5	750 75	—
10	1575 0	2 10
20	3505 0	2 22
Average ratio		2 202

MEN SWIMMING

Distance (yards)	Time (seconds)	Ratio of times
25	12 2	—
50	24 6	2 02
100	58 0	2 36
200	140 0	2 42
400	297 0	2 12
800	628 0	2 12
Average ratio		2 208

The law has been tested and found to hold good for horses running trotting, and pacing, and for men walking, running, rowing swimming, and skating It does not hold, on the other hand, for bicycling a not unnatural result, when the importance of the machine as well as the rider is considered [1]

If T denote the record time and L the distance, the law may evidently be put in the form

$$T = A L^{n} \qquad (1)$$

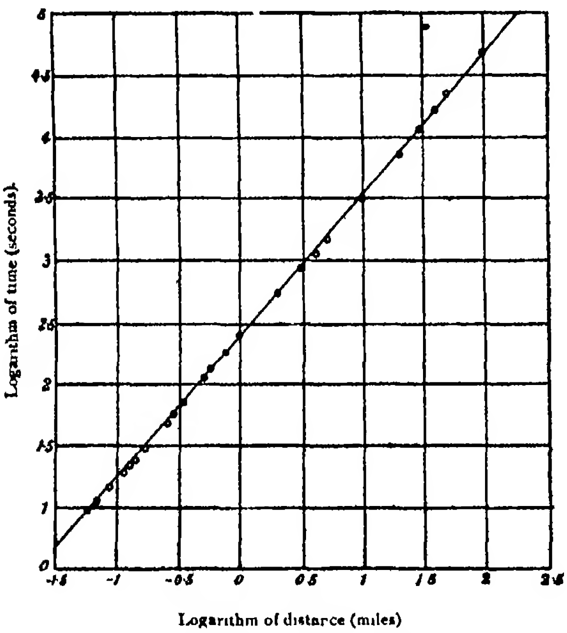
[1] Cf the work of M Bouny (Paris Academy of Sciences, and NATURE, vol liv , 1896), and R E Crompton (NATURE vol lxi 1899)

where n is a constant and A varies with the animal and the mode of progress. That is, in terms of logarithms,

$$\log T = \log A + n \log L \qquad (2)$$

Hence, if T and L are plotted on logarithmic paper, or their logarithms plotted on ordinary scale paper, the points obtained will lie more or less closely round a straight line. If a line be run as near as may be through the points, its slope will give the value of n. This is the procedure adopted by Mr. Kennelly, and he finds an average value of n equal to 9/8, corresponding to a ratio of the times for double distances 2·181. To illustrate the closeness of the logarithmic law from data that are readily accessible in England, we have plotted a diagram from the table of running records in "Whitaker's Almanack" (p. 415), taking, like Mr. Kennelly, the lowest record, whether amateur or professional, in each case. We must refer the reader to the original paper for numerous diagrams, on a somewhat larger scale, illustrating the records in the other cases.

The author concludes, we think correctly, that a



Men running: logarithmic graph of record time and distance, 100 yards to 100 miles.

record is more likely to be lowered if it correspond to a point lying above the time-distance line than if it correspond to a point lying below it, and hence the graph may be of service to the athlete. He also argues that, as a consequence of the law, an athlete should adopt such a speed in running that he can just maintain it constant to the end of the course and is then completely exhausted. But the energy of the individual is not exhausted suddenly in this way, and, although the conclusion may concur with practice, we do not think that it follows from the given law of record speeds. We agree with the author that more information is wanted on this head. It seems doubtful, in fact, if the observed rule should be termed a "law of fatigue" at all; it is not a law of the variation of speed, with time or distance, for the same individual running his fastest continuously, nor even of the average speeds of the same runner over different distances when he knew in advance the distance to be run. It is a law relating times to distances when the best possible runner is selected for each particular distance. This involves the adaptation of the individual as well as fatigue. How much it involves adaptation or selection is illustrated by the complete disagreement of the older with the more recent records for the case of trotting horses. For the longer distances only old records are available, and these fit much better with the older records for short distances (cf. *Encycl. Brit.*, xii., 205) than with the more recent records given by Mr. Kennelly.

We cannot help hoping that a knowledge of "Kennelly's Law" will soon be widely diffused, the possibilities of its educational influence seem almost unbounded. The bookmakers will take to studying "Chambers' Tables", betting books will be bound up with a few pages of logarithmic paper for the purpose of entering, shall we say, "recordograms", and Jones Minor, callous to the beauties of logarithmic graphs when illustrated by the laws of steam or the behaviour of purely symbolic barges on non-existent canals, may awaken into something resembling life when racing records are in question. Schoolmasters need not hesitate for fear of corrupting youth, the necessary data can be taken from either of those most respectable publications, "Whitaker's Almanac" and the "Encyclopædia Britannica."

G. U. Y.

PROF. H. W. BAKHUIS-ROOZEBOOM.

CHEMISTS have received with great sorrow the news of the death of Prof. H. W. Bakhuis-Roozeboom on February 8. Roozeboom was struck down in full activity, and science might have hoped to have been enriched by his work for years to come. At the beginning of February, however, he was attacked by influenza; apparent recovery was followed by pneumonia, which in three days proved fatal. He leaves a widow and five children.

Hendrik Willem Bakhuis-Roozeboom was born on October 24, 1854, at Alkmaar, a little town some twenty miles north of Haarlem, noted in history for the first successful resistance made against the Spaniards in the struggle for Dutch independence. He was educated in his native town at one of the higher burgher schools, where so excellent an education on modern lines is given. Even during his school career his unusual ability gave promise of a notable future. After leaving school he assisted his chemistry master, Dr. Boeke, for some time in making a number of soil analyses in connection with the plan which is still under discussion of draining the neighbouring Zuider Zee. Not thinking at first of an academic career he accepted a position in the butter factory of Dr. Mouton at the Hague, and it was the circumstance of the factory being burnt down in 1878 which decided his future. Hearing of the fire, a brother-in-law of Dr. Boeke, van Bemmelen, professor of chemistry at Leyden, offered Roozeboom the post of assistant. This he decided to accept, and while thus occupied he carried on his studies in the University of Leyden, and graduated in 1884. He remained at Leyden as docent, and later as lecturer, supplementing his small university stipend by teaching in the girls' higher burgher school and by translating English books into Dutch, until on the removal of van 't Hoff to Berlin in 1896 he succeeded him as professor of general chemistry in the Uni-

versity of Amsterdam, and this chair he held until the time of his death.

In the Dutch universities seven years is the minimum period of study required for graduation, and the last of these is devoted to original research. The work undertaken by Roozeboom on the hydrates of the halogens and their hydrides led him at once to the problems with which his name will always be associated.

In the course of his experiments he came upon phenomena which he was unable to explain. At that time the conditions which determine equilibrium in chemical systems were little understood by chemists. About ten years before, the American physicist Willard Gibbs, had developed a theory of equilibrium between materials in contact which was completely independent of all assumptions as to the nature of matter or as to molecular structure. Given a system constituted of homogeneous portions (phases, as they are called, P in number) separated from each other by definite surfaces of contact, and made up of constituents (components, as they are termed, C in number) the amounts of which present in the system can alter independently of the others, Gibbs had shown that, considering only the temperature and pressure under which the system exists and the concentration of the components, the number F of the latter conditions (degrees of freedom, as they are called) to which arbitrary values must be assigned to describe the system perfectly are given by the expression $F=C-P+2$, this numerical relationship being known as the "phase rule."

Gibbs had published his results in a journal not widely circulated—the Transactions of the Connecticut Academy. They were, moreover, presented in a mathematical form unfamiliar to chemists, and had consequently remained scarcely noticed all these years. Prof. van der Waals, to whom Gibbs's work was known, hearing of Roozeboom's difficulty, suggested to him that this mode of regarding equilibrium might throw light upon it. Roozeboom's philosophical mind at once grasped the immense possibilities of this new method of regarding problems of equilibrium, and from that time he occupied himself with brilliant success in working out its application to chemistry.

The investigations of Roozeboom and of those whom he interested in this branch of physical chemistry have cleared up our ideas in a surprising way, and opened out fresh paths of inquiry in the attractive region which connects chemistry and physics. The great merit of first applying the phase rule in chemistry must be attributed to Roozeboom, and gives him a high place among the founders of the new chemistry.

An account of the many applications of the phase rule to chemical problems was written by Roozeboom in his well-known book "Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre," of which two parts only have yet appeared. He had prepared all the necessary material, and was about to begin writing the third and concluding part at the time of his death.

Apart from scientific work his life was uneventful. His simplicity of character and extreme desire to do justice to every fellow-worker won him the affection of all who came to know him well. In 1890 he was made a member of the Royal Academy of Science of Amsterdam. Totally devoid of any trace of the advertising spirit, he received fewer public honours than might have been expected to follow his notable achievements, and everyone must feel regret that the scientific world did not in his lifetime more adequately recognise his services.

F. D. CHATTAWAY.

NOTES

THERE is every likelihood that Lord Lister's eightieth birthday, on April 4, will be suitably celebrated by his friends and admirers. A committee is being formed consisting of representatives of medicine and science with a view to carry into effect a suggestion made, we learn from the *British Medical Journal*, by Dr. C. J. Martin, F.R.S., the director of the Lister Institute. Dr. Martin has proposed that the best form in which to convey to Lord Lister the admiration and regard of his fellow-workers and followers would be the re-publication of all his scientific papers prefaced by a biography of Lister containing an account of the part he took in the development of present knowledge of infectious processes and of his efforts to avoid wound infection, the successful result of which revolutionised surgery. Dr. Martin will be glad to receive at the Lister Institute, Chelsea Gardens, S.W., the names of persons who desire to participate in this happy idea.

Science announces that the Rumford medal of the American Academy of Arts and Sciences "for discoveries in light and heat" has been awarded to Prof. E. F. Nichols, of Columbia University.

THE death is announced, in his seventy-fifth year, of Sir Thomas Hanbury, K.C.V.O., at one time of Shanghai, the founder of the Hanbury Botanical Institute at the Royal University, Genoa, and of the Museum Prehistoricum, near Mentone.

WE learn from the *Athenaeum* that the third congress of the Prehistoric Society of France will be held at Autun on August 13–18. Excursions will be made to Macon, to Mont-Auxois (the ancient Alesia), to Mont-Beuvray (the ancient Bibracte), and to Solutré. Dr. Marcel Baudouin, 21 rue Linné, Paris, is the secretary.

PETITIONS in support of the Metric Weights and Measures Bill, which is down for second reading on March 22, are being signed by many public bodies and institutions throughout the country. Among the petitions already received by the Decimal Association for presentation to the House of Commons is one signed by the headmaster and the whole teaching staff of Eton College.

THE model of the Channel Tunnel which was on view at Caxton Hall, Westminster, during last week was well patronised, and the voting of those who have inspected it has resulted in a large majority in favour of the scheme. The model is well made in sections, which show clearly the positions of the proposed tunnels in the chalk and the direction of the strata. An interesting point is the very slight variation of level which occurs at this part of the Channel bed.

THE death is announced of Prof. A. Y. Tsvetkoff, of the Moscow Petroffsky Forestry Institute. Soon after finishing his studies at the St. Petersburg University he obtained the degree of Master of Mathematics by a dissertation on surfaces subject to change without rupture or bend of their component parts. In 1864 he was commissioned by the Department of Agriculture abroad, and on his return he became extraordinary professor of the Moscow Institute of Forestry and Agriculture. In 1873 he became professor of mathematics at the Lycée. He read lectures also on physics and meteorology, and his auditorium was always crowded. In 1885 he retired owing to illness. He was most generous in helping poor students and others, and only after his death was it found that he had given away several thousand roubles in this way.

IN the House of Commons on March 7 the President of the Board of Agriculture was asked whether, in view of the loss now sustained by fruit growers, it is the intention of the Government at an early date to propose legislation which will enable insect and other pests which infect fruit to be dealt with effectually; and if it is intended to propose legislation, whether the Government will use every endeavour to bring it into force by May, in view of the fact that the disease will during that month begin to spread from the affected gooseberry plantations. In reply to the question, it was stated that the President of the Board of Agriculture hopes very shortly to be in a position to introduce legislation to confer on the Board and on local authorities further powers to deal with insect and other destructive pests.

AMONG the lecture arrangements at the Royal Institution after Easter we notice the following:—Prof. G. H. Bryan, two lectures on wings and aeroplanes; Prof. W. Stirling, three lectures on stimulation, luminous and chemical; Prof. G. H. F. Nuttall, two lectures on malaria, sleeping sickness, tick fever and allied diseases; Prof. H. A. Miers, two lectures on the birth and affinities of crystals; Mr. H. F. Newall, two lectures on spectroscopic phenomena in stars (1) chemistry, (2) motion; Sir James Dewar, three lectures on chemical progress—work of Mendeléeff and Moissan; Prof. S. P. Thompson, three lectures on studies in magnetism (the Tyndall lectures); Prof. W. C. McIntosh, two lectures on scientific work in the sea fisheries; and Sir Wm. H. White, two lectures on the contest between guns and armour. The Friday evening meetings will be resumed on April 12, when a discourse will be given by Prof. A. H. Church on conservation of historic buildings and frescoes; succeeding discourses will probably be given by Prof. C. S. Sherrington, Sir James Crichton-Browne, Prof. G. Chrystal, Prof. J. A. Fleming, Mr. A. H. Savage Landor, Sir James Dewar, and others.

A REUTER telegram from Rome on March 4, published in the *Times*, supplies information as to the programme of the Italian Government in the matter of the excavations at Herculaneum and other archæological schemes in Italy. It has been decided that the work shall be undertaken by the Italian Government, and the archæologists in charge of the Herculaneum excavations will probably be Profs. Dall'Osso and Pellegrini, of the University of Naples, Prof. Gabrici, of the Naples Museum, and Profs. Savignoni and Mariani. The Minister of Instruction, Prof. Rava, is making antiquities his special care, and has obtained the funds necessary to carry out an extensive programme. The yearly sum to be expended for antiquities and fine arts has been raised to nearly a quarter of a million pounds, and the appropriation for excavations has been doubled. The Minister has ordered the beginning on a large scale within a year of excavations at Ostia, the port of ancient Rome; excavations at Pæstum to find the remains of the great edifices of which Greek and Roman historians have spoken; he has obtained permission to expropriate all the houses surrounding the baths of Diocletian, and is spending 20,000*l.* to free those grand remains; and finally he has obtained 240,000*l.* for the construction of the proposed archæological promenade, which is to be finished within three years. It will start from the Roman Forum, and will pass by the Colosseum, going so far as the Baths of Caracalla on one side and the Baths of Titus and Trajan on the other.

SIR W. H. PERKIN, F.R.S., presided at the annual dinner of the Society of Dyers and Colourists on March 8. Prof. Meldola, F.R.S., proposed the toast of "The Society," and said the dinner was fittingly held on the 100th anniversary of the introduction of coal gas as an illuminant in the streets of London. The society was, therefore, doubly pleased to welcome as its president the founder of the coal-tar colour industry. The introduction of the scientific spirit into this industry is largely due to the work of Sir W. Perkin. The society is doing a great work in the particular industry represented by it, especially in bringing together representatives of the industry and of science bearing upon the industry. Good work which the society is developing is, said Prof. Meldola, the system of giving prizes for the solution of technical problems. It is a departure which can only be commended, and it is to be hoped it will be imitated by many other technical societies. The president, in reply, referred to the great advances made in other countries in the coal-tar industry during recent years, and urged manufacturers in this country, in order to maintain their supremacy in this industry, to employ in their works the services of the best scientific men. Sir W. Perkin declared that the time for energetic research is while business is prosperous. If that is done there is very little probability of decline. In commemoration of the connection of Sir W. Perkin with the society the council has decided to found a Perkin medal, which will be conferred for inventions of striking scientific and industrial merit connected with the tinctorial industry.

THE Commercial Motor Vehicle and Motor Boat Exhibition, which was opened last week at Olympia by the Lord Mayor, is likely to prove a great success, as every kind of commercial interest is well catered for. The exhibits shown include various new forms of motor 'buses, lorries, chars-à-bancs, a motor police ambulance for London, numerous forms of trade vans, and a motor horse-box. Not the least interesting of the exhibits from an Imperial point of view is the motor van which is shortly to tour the country showing Canadian products. Tyres of all descriptions, and non-slip bands and devices, occupy the gallery, and various new oils for motor lubrication are also much in evidence. Some well-finished motor boats are shown, the largest being a launch about 40 feet in length, made and fitted for the use of the Plymouth Port medical officer. A notable feature in this section is the increase in the number of boats which are propelled without the use of petrol, the paraffin engine being largely installed instead, thus obliterating one of the greatest objections to the motor boat, *i.e.* the danger of the petrol exploding. The boats are in some cases fitted with a seat for the driver similar to that in a car, and are provided with a brake. From a business point of view the exhibition should prove of great value, and is also of great interest as showing the progress made recently in heavy motor traction.

A MEETING was held on March 7 to aid the work of the National League for Physical Education and Improvement at Londonderry House. The aims of the league are to stimulate public interest in the physical improvement of the people, to coordinate and extend the work of existing agencies, to make known the legal powers already possessed by public authorities, and to promote fresh legislation where necessary. Lord Londonderry presided, and in his opening remarks said there are few persons who are studying the condition of the people of this country who do not recognise the importance of hygiene and physical education. In dealing with the question of the teaching of hygiene in the schools, he said that medical inspection

of the children should be periodically carried out, children should not be worried by over-inspection, and discretion should be exercised. As to the instruction of the children in the rules of health, care should be taken to use language which the child understands. Sir Lauder Brunton, in the course of an address, said that, in spite of all the charitable organisations and benevolent institutions in the country, infants are dying in millions, children are starved by thousands, they become weak, they are growing up burdens to themselves and useless to others, and instead of being a strength to the country they weaken it. The great weakness, misery, and crime in this country can only be attacked successfully by means of cooperation. The National League is endeavouring to effect the cooperation which is so much needed by bringing together all the individuals and corporations who are interested in the welfare of the coming generation.

A DISCUSSION on the best types of cases (combining economy with suitability) for exhibition purposes occupies a large portion of the February number of the *Museums Journal*. An article illustrated by an excellent photograph is also devoted to the new wing recently added to the Liverpool Museum.

IT appears from a paper by Dr. D. Woolacott in vol. ii., part vi., of the Proceedings of the University of Durham Philosophical Society that a raised beach in the Cleadon Hills has been unusually well exposed during the last two years. The beach is 100 feet above sea-level, but caverns and a sea-cliff indicate that the most recent depression of the country was as much as 150 feet.

THE combined January and February numbers of the *Irish Naturalist* are devoted to an account of the natural history and geology of Lambay Island, county Dublin, now in the occupation of the Hon. Cecil Baring, under whose auspices the investigation has been undertaken, and who has himself contributed notes on the seals and other mammals. A number of naturalists have contributed to the work, which has resulted in the discovery of five new species of invertebrates, and has likewise added several forms to the British fauna and a much larger number to the fauna of Ireland.

WE have been favoured with a copy of a paper from the *Jenaischen Zeitschrift* (vol. xxxix.), by Prof. Hubrecht, on the origin of annelids and chordates and the systematic position of the Ctenophora and Plathelminthes. As the "trophocœle" and "hæmocœle" theories are discussed at length, especially from the point of view of Prof. Lang, it is scarcely necessary to mention that the paper is of an extremely abstruse nature. Much importance is attached to the view that the Ctenophora are pelagic worms rather than cœlenterates, and that the Plathelminthes are likewise an aberrant type.

To the fourth part of vol. xxxvi. of Gegenbaur's *Morphologisches Jahrbuch*, Auguste Arnbäck-Christie-Linde contributes the first portion of a paper on the shrew-mice (Soricida) and their relationship to other mammals. This section of the paper is devoted to the anatomical part of the subject. It is mentioned that a lateral gland occurs in the males of the common shrew-mouse (Sorex) and water-shrew (Crossopus). Although the occurrence of such glands in the musk-shrews (Crocidura), generally in both sexes, is well known, no reference is made to their presence in the British species in such text-books as we have been able to consult.

REFERENCE in these columns was recently made to Prof. Baldwin Spencer's description of emeu bones from King Island, Bass Strait. To the January issue of the *Emu* Colonel Legge contributes notes on the extinct emeus of both that island and Tasmania. The author recalls having seen a pair of Tasmanian emeus in his boyhood, and states that they were slightly smaller than the mainland species. As this bird also lays a larger egg, it is regarded as distinct, although it does not appear to have received a scientific name. Colonel Legge withdraws, in a postscript, a name he proposed in the text for the King Island bird, owing to it having been already christened by Prof. Spencer.

"PARENTAL Care among Fresh-water Fishes" is the title of a very interesting article by Mr. Theodore Gill published in the Smithsonian Report for 1905 (art. No. 1688). Despite Aristotle's account of the care displayed by the Macedonian glanis in the preparation of a breeding-site, it was long an axiom among naturalists that fishes displayed no parental care for their eggs and offspring. How erroneous was this idea is sufficiently exemplified by the present account, although it deals only with species inhabiting fresh waters. Representatives of a very large number of groups exhibit some degree of parental care, although this may be limited to clearing a space to receive the spawn. The highest development in this respect occurs in the sticklebacks, in which the kidneys and their adjuncts are specially modified to yield a thread employed in the construction of the nest.

IN the shell-gallery of the Natural History Museum have been placed full-sized *papier maché* models of two giant cephalopods, an Architeuthis and an Octopus or Polypus. Being suspended from the roof, they show to great advantage, and convey a good idea of the huge size attained by certain members of the class, although much larger forms are known. The giant squid, or Architeuthis, measures 40 feet in total length, although 30 feet of this are accounted for by the pair of attenuated tentacular arms, the length of the body being only 10 feet. An additional interest attaches to this cephalopod on account of its constituting a large portion of the food of the cachalot. The models were obtained from Ward's Natural Science Establishment, Rochester, U.S.A. Another important addition to the collection is formed by two caribou, shot and presented by Mr. F. C. Selous, one representing the Yukon and the other the Newfoundland race. The former has antlers measuring just above 58 inches along the curve.

THE report of the Botanical Club of Canada for 1905–6, prepared by the secretary, Dr. A. H. Mackay, has been received. It contains, as usual, a summary of the phenochrons or observations on the flowering of plants and other natural phenomena recorded from several hundred schools throughout Nova Scotia, and a table of general Canadian phenological observations. Dr. Mackay has also published a handy bibliography of Canadian botany for the year 1905.

IN the *Lyttelton Times* (December 19, 1906) Dr. L. Cockayne pays a tribute to the work of the late Mr. Robert Brown, of Christchurch, New Zealand. By profession a shoemaker, he was at the same time an enthusiastic naturalist, keenly interested in the fauna and flora of the country. He devoted his energies primarily to the collection and identification of the New Zealand mosses, and contributed numerous papers during the last fourteen years that will be found in the Transactions of the New Zealand Institute.

An insidious disease of the cocoa-nut palm, known as "bud rot," has been recognised for a considerable time, but the primary cause was not determined. The view is now held that decay is due to bacteria developing in the slimy coating found on the young protected organs. Although certainly existent in the East Indies, there was no record of its occurrence in Ceylon until last year a case was brought to the notice of the Government mycologist Mr T. Petch. The disease and its treatment are noted in vol. iii., No. 15 of the Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon. In No. 17 of the same series Mr Petch describes the root disease of the Para rubber tree caused by the bracket fungus, *Fomes semicostatus*.

In the course of an article in vol. i., No. 10 of the *Philippine Journal of Science*, on the active constituents of certain medicinal plants, Mr R. F. Bacon refers to the substances used by the Filipinos for stupefying or poisoning fish. The fibre of *Entada scandens*, the bark of *Ganophyllum obliquum* and the fruit of *Croton Tiglium* are commonly employed for the purpose. The two former contain saponin, the latter a poison allied to ricin, but it is not considered dangerous to eat fish poisoned by these substances. On the other hand, there is risk attending the consumption of fish poisoned with the fruits of *Anamirta cocculus* on account of the picrotoxin contained. The fruits of *Derris polyantha* and *Diospyros canomoi* are also used.

The Local Government Board has just issued a report on the micrococcus of epidemic cerebro-spinal meningitis (spotted fever), a disease which recently appeared in Glasgow, Belfast, Liverpool, and other places in the British Isles. The report is compiled by Dr M. H. Gordon, and contains full details of the characters of the microorganism and its recognition.

The *Journal of Hygiene* for January (vii., No. 1, just issued) contains a number of interesting and important papers. Dr Castellani describes certain cases of tropical fever associated with apparently new species of bacilli, Messrs Dudgeon and Dunkley discuss the *M. neoformans*, found in cancer by Doyen, Prof. Hewlett and Mr Barton outline the results of a chemical, microscopical and bacteriological examination of twenty-six samples of London milk, and Dr Arkwright describes the *M. catarrhalis* met with in nasal catarrh, and its differentiation. Fleet-Surgeon Bassett-Smith, R.N., contributes an important paper on the treatment of Mediterranean fever by means of vaccines. Although a few cases did well, on the whole the results were disappointing.

We have received the first number of the "Annals of Tropical Medicine and Parasitology," edited by Prof. Ronald Ross, F.R.S., and issued by the Liverpool School of Tropical Medicine. It is intended to take the place of the separate memoirs on tropical medicine which have hitherto been issued by the school, and is to be issued at the subscription price of 10s. 6d. per volume of probably not less than four numbers. The present number, of 161 pages, contains an elaborate memoir by Messrs Newstead, Dutton, and Todd, on insects and other arthropods collected in the Congo Free State, illustrated with six plates; descriptions of two new species of African ticks, by Prof. Neumann, and of parasites in the Liverpool School Museum, by Prof. Looss; a paper on the presence of *S. duttoni* in the ova of the tick, *Ornithodoros moubata*, by Captain Carter, I.M.S., and a note on the therapeutics of trypanosomiasis, by Messrs. Moore, Nierenstein, and Todd. The number is excellently printed and illustrated, and the general "get-up" all that can be desired. It bids fair to be one of the most important journals on tropical medicine in its scientific aspects.

In the *Naturwissenschaftliche Wochenschrift* (vol. vi., No. 8) Prof. H. Potonié gives an interesting historical summary of the various theories that have been propounded to explain the genesis of coal.

A paper contributed by Mr W. R. Thomas to the Institution of Mining and Metallurgy, and published in the Bulletin (No. 29) of the institution, strikingly illustrates the manner in which modern mining appliances and methods are now being adopted in Cornwall. It describes the electrically-driven centrifugal pumping plant at the Tywarnhaile mine. Special interest is attached to the installation from the fact that Dowson gas is used to run the electric plant. The results obtained have proved eminently successful.

Advance statistics, subject to correction, issued by the Home Office, show that the British output of coal in 1906 was 251,050,809 tons, or 6.33 per cent. more than in 1905. The number of persons employed at the coal mines in 1906 was 882,345. The mineral production also included 2,971,173 tons of fireclay, 8,209,880 tons of ironstone, 2,546,113 tons of oil-shale, 1,824,415 tons of iron ore, 230,558 tons of rock salt, 151,915 tons of salt from brine, and 126,699 tons of slate. The number of persons employed at mines under the Metalliferous Mines Regulation Acts was 29,969.

In a paper read before the Society of Arts, published in the Journal of the society of March 8, Prof. W. Boyd Dawkins gives a summary of the results obtained in the investigation of the south-eastern coalfield. The paper contains a map of the coalfield between Dover and Canterbury, and sections of the strata in the borings at Dover, Penshurst, Ellinge, Brabourne, Waldershare, and Fredville. At present, the seams proved are at Dover, thirteen seams with an aggregate thickness of 22½ feet; at Waldershare four seams 10 feet 3 inches thick, and at Fredville, three seams 7 feet thick. At Dover the coalfield is about 1000 feet below Ordnance datum. At Ropersole the Coal-measures were struck at a depth of 1180 feet, and at Ellinge at 1815 feet. Prof. Boyd Dawkins takes an optimistic view of the future of the coalfield, which he regards as an important national asset and a striking instance of the value of scientific research to the nation.

Very high temperatures are required in tempering the modern special tool-steels, and care has to be taken that contact with carbon or air is avoided lest the composition of the steel should be altered. A novel type of electric tempering furnace designed by Körting Brothers is described in *Engineering* of March 1. The steel is placed in a fused salt, which must have a high melting point and should not evaporate to any great extent at high temperatures. With barium chloride a temperature of 1300° C. can be maintained in such a furnace. The furnace forms a square box built up of iron, asbestos, and fire-bricks, leaving in its interior a cubical crucible chamber. This space is filled with the salt, and two plates of iron attached to opposite walls serve as electrodes for the alternating currents, supplied by an oil transformer. When the salt is fused, the object is lowered into the molten mass and the temperature controlled by means of a pyrometer and rheostats. The tools may be pre-

heated up to red glow before being placed in the furnace Primary currents of 50 or 100 periods and 200 volts are used. When keeping the furnace at its maximum temperature of 1300° C. for ten hours a day, about 2 lb. of barium chloride have to be replenished every day The furnace lining is said to last about a year, the iron electrodes do not last so long Barium chloride seems so far to be the best material for the extreme temperatures For lower temperatures mixtures of barium chloride and potassium chloride are used The crust of fused salt which adheres to the steel peels off at once when the steel is dropped into the cooling liquid Local superheating is not to be feared in this kind of furnace and the application of fused salts is attracting much attention

An interesting discussion on the advantages and disadvantages of heating buildings with gas stoves of various types, which was held at the meeting of the Royal Sanitary Institute on December 12 of last year is printed in the March number of the Journal of the institute Dr Rideal in opening the discussion considered that as soot, carbon monoxide, and hydrogen sulphide are never present in the products of the combustion of coal gas in modern gas-stoves and as the proportion of oxygen in the air of a room is little changed when the heating is effected by a flueless gas stove the use of flueless stoves was in several cases an advantage especially when the economy of the heating effect was considered The amount of carbon dioxide produced was not sufficient to be deleterious and instead of causing defective ventilation flueless stoves especially those of a condensing type seemed actually to remedy it Several speakers took part in the discussion many of them dissenting from the views expressed by Dr Rideal In particular the passage of sulphur acids into the air when a flueless stove is used appears to present difficulties

MESSRS JOHN J GRIFFIN AND SONS LTD yesterday entertained a number of visitors at their new premises in Kingsway New physical and other apparatus were exhibited and there were demonstrations of the properties of vessels made of silica glass of the oil pigment process velox printing among modern processes in photography the wireless transmission of signals the musical arc, and other physical phenomena This opportunity of seeing instruments and processes in operation is likely to be appreciated by teachers and others and Messrs Griffin and Sons Ltd will probably be repaid for their enterprise

OUR ASTRONOMICAL COLUMN

DISCOVERY OF A COMET (1907a).—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Prof Giacobini at the Nice Observatory The object was of the eleventh magnitude and its position at March 9d 10h 10.9m (M.T. Nice) was

R.A =7h 4m 31.4s dec =18° 21′ 17″ S

The daily motion is westward at the rate of 47′ and northward at the rate of 57′ per day The above position lies in the constellation Canis Major, about 20′ E and 1½° S of Sirius

SOLAR RESEARCH AT MEUDON.—In No 5 (1907) of the *Comptes rendus*, MM Deslandres and d'Azambuja describe, and give some of the preliminary results of the solar researches carried out at Meudon with several forms of spectrographs, during the year 1906 One of the principal difficulties encountered by M Deslandres in his previous experiments has been to obtain a satisfactory slit so narrow that the finer dark lines of the spectrum might be completely isolated and this difficulty was, to a great extent overcome during the recent research by drawing a very fine clear line on the surface of a piece of chemically silvered optical glass By having a clear space above and below the slit the solar spectrum was simultaneously photographed on each plate, thereby enabling the parallelism of the slit and the line and the exactitude of the setting on the line to be tested for each exposure

Photographs taken on the centres of the fine iron lines at λ 4045 and λ 4385 are found to differ considerably from those taken on the degraded edges of the lines for whilst the latter show simply the bright facular areas the former show a net work of bright inequalities of very different form the photograph with the setting on the centre of the line is supposed to represent the upper layers of the iron vapours The differences between the images obtained with the K_1 and K_2 lines are not so marked as was expected although many of the bright areas obtained with the latter are not to be found on the K_2 images No relation between the K_1 images and the dark calcium flocculi of Prof Hale's photographs could be established nor could the similarity of the former with the dark areas produced by photographs on the dark hydrogen lines be recognised

THE MARKINGS AND ROTATION PERIOD OF VENUS.—Mr Denning in continuing his series of articles on the planets in the March number (No 381) of the *Observatory* discusses the contradictory results which have been derived from observations of Venus concerning the existence of permanent markings on the planet's surface and the time it takes the planet to perform one rotation on its axis He points out that whilst Mr Lowell records that he has seen the markings when their contours have "had the look of a steel engraving" numerous other very careful observers have failed to distinguish anything which might be recognised as permanent Similarly a large number of observers have arrived at the conclusion that the rotation period is about 23h–24h whilst others including Schiaparelli have concluded that it is about equal to the period of the planet's revolution in its orbit The spectroscopic results are similarly in opposition

Summing up the results of the discussion Mr Denning concludes that after the earnest application of observers during three centuries the problems of the configurations and of the axial rotation remain unsolved the difficulties having as yet proved insuperable

THE ELECTRICAL INFLUENCE OF THE SUN.—No 8 vol vii (February 23) of the *Revue Scientifique* contains an interesting discussion by Dr A Nodon of the electrical influence of the sun on the earth

After giving a historical account of the subject, the author proceeds to describe the experimental results obtained by M Brunhes and by himself from which follows the deduction that the sun produces at the earth's surface a positive electrical induction of variable magnitude The amount of this induction is far greater than that attributable to the actino-electric action of the luminous radiations whilst the interposition of clouds before the sun arrests the induction effect Other possible causes are discussed and it is shown that independently of these there still remains an effective induction directly due to the sun's charge alone

In a second part of the discussion published in No 9 of the same journal Dr Nodon considers the effect of the solar influence on the planets on comets and on the earth in particular and in conclusion he urges the fundamental importance of the study of solar physics on the grounds that a large number of meteorological phenomena appear to be directly connected with the solar changes

RECENTLY DISCOVERED ASTEROIDS.—The provisional elements of the orbits of twenty-five recently discovered asteroids are published in No 4156 (February 21) of the *Astronomische Nachrichten* by Herr J Bauschinger of the Astron Rechen-Institut Berlin These asteroids were discovered between August 1905 and April 1906 and their designatory numbers range from 570 to 598

SURVEY OF SCOTTISH LAKES

DURING the past three or four years the bathymetrical survey of 554 of the fresh-water lochs of Scotland has been completed under the direction of Sir John Murray and Mr Laurence Pullar This practically means that all the Scottish fresh-water lochs have now been surveyed, except some small ones on which no boats could be found A large staff has been employed during the course of the work—about forty voluntary and paid assistants, in addition to a great many boatmen and other workmen Up to the present time, the charts of 180 lochs, with descriptions, have been published in the *Geographical Journal*, and arrangements have now been made for the publication in the same journal during the present year of the descriptions and charts of the thirty-three lochs in the Ness basin This will complete the publication of the observations made in the more important lochs The results obtained in the case of the remaining 340 lochs will be published, as a special volume, by the Royal Geographical Society in about eighteen months from this date, the charts being at present in the course of printing by Mr. J G Bartholomew

Besides the purely bathymetrical aspect of the survey, papers have been published by Prof Chrystal on seiches, by Mr E M Wedderburn on the temperature of Loch Ness, by Mr E R Watson on ionisation of air in vessels immersed in deep water, by Dr Wesenberg Lund on a comparative study of Scottish and Danish lakes, by Prof Bachmann on phytoplankton of Scottish and Swiss lakes, by Mr G West on aquatic plants, by Mr James Murray on fresh-water animals by Drs Peach and Horne on the geological surroundings of the lochs, and other papers [1]

The last published paper [2] treats of the lochs within the basin of the Lochy the relative positions of which are shown in the little index map of the district (Fig 1) The total area of the basin exceeds 400 square miles, the diameter from east to west exceeding forty miles, and from north to south exceeding twenty miles. Of the ten lochs within the basin, five exceed three miles in length and four exceed five miles in length, while Loch Lochy is nearly ten miles, and Loch Arkaig twelve miles, in length; five of the lochs exceed 100 feet in depth, and three exceed 300 feet in depth, while Loch Lochy exceeds 500 feet in depth, five of the lochs cover a superficial area in each case exceeding a square mile, and four exceeding two square miles, while Loch Arkaig and Loch Lochy each cover an area of about six square miles The two largest lochs (Arkaig and Lochy) drain into the River Lochy, while the remaining lochs within the basin (Pattack, East and West na h-Earba, Laggan, Ossian, Ghuilbinn, Treig, and an Dubh Lochan) drain into the River Spean, which joins the River Lochy shortly after its exit from Loch Lochy, the little Loch nan Gabhar and Lochan Lùnn dà-Bhrà drain by independent streams into Loch Linnhe. In these twelve lochs, which cover an area of about twenty square miles, nearly 2600 soundings were taken, or an average of 214 soundings per loch, and 129 soundings per square mile of surface, the aggregate volume of water contained in the lochs is about 85,855 millions of cubic feet, or more than one-half of a cubic mile, and the area draining into them is more than 270 square miles, or fourteen times the area of the lochs.

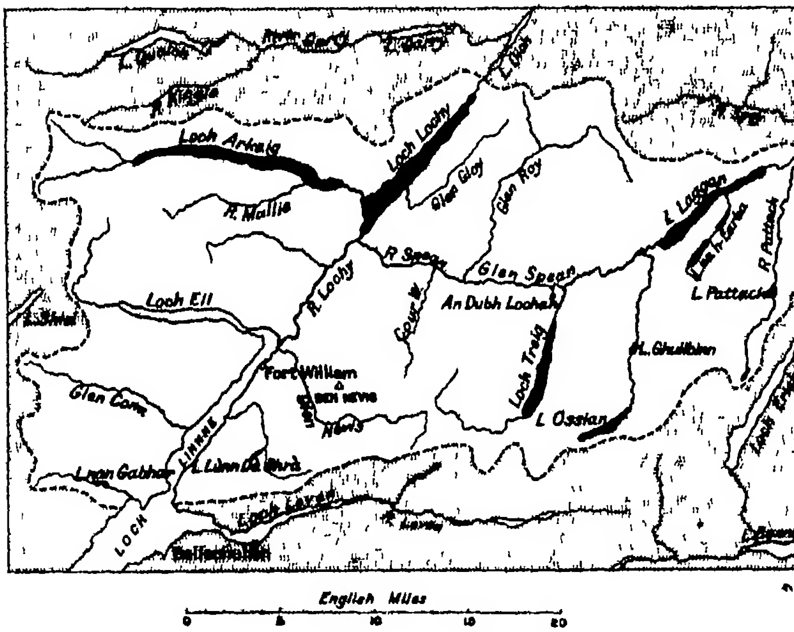


Fig 1—Index Map of the Lochy District

Loch Lochy (see Fig 2), the southernmost of the chain of lochs occupying the Great Glen utilised in forming the Caledonian Canal, is a straight loch, having the form of a narrow triangle with the apex at the north-east end, whence it widens gradually southward to Bunarkaig, where the maximum breadth of a mile and a quarter is found, the average breadth of the whole loch being three-fifths of a mile The superficial area is nearly 3800 acres, and the volume of water about 37,726 millions of cubic feet, the maximum depth being 531 feet and the mean depth 229 feet All the contour lines are continuous, the 100-feet contour enclosing an area little less than the total length of the loch, while the areas enclosed by the 200-feet 300-feet, and 400-feet contours are respectively 6½, 4½, and 3 miles in length The 500-feet contour encloses a very small area, one-third by one-eighth of a mile, just about the middle of the loch

Loch Arkaig (see Fig 3), a long, narrow, curved loch, trending nearly east and west, lying about a mile to the west of Loch Lochy, is of somewhat irregular outline, broadest in the middle parts, where the loch is nearly a mile wide, and tapering towards each end, the mean breadth being half a mile The superficial area is about 4000 acres, and the volume of water about 26,573 millions of cubic feet, the maximum depth being 359 feet and the mean depth 153 feet The basin is nearly simple, the slight irregularities being doubtless correlated with the curving outline. The 100-feet contour is continuous but the 200-feet contour is broken into two basins, and the 300-feet contour into three basins The largest 300-feet area, just about the middle of the loch, is two miles in length, and includes the maximum depth of 359 feet [1]

Loch Treig occupies a deep, narrow valley trending north and south among very high mountains in the region of Lochaber, the West Highland Railway running along the east side It is more than five miles in length, with a maximum breadth of three-quarters of a

[1] See Trans. Roy Soc Edin, vol xli pp 367, 599, 677, and 823, vol. xlv., p. 361, Proc. Roy Soc Edin, vol xxv, pp 1, 401, 593, 609, 637, 967, *Geogr Journ*, vol xxiv, p 429

[2] "Bathymetrical Survey of the Fresh water Lochs of Scotland" Under the direction of Sir John Murray, K C B, F R S, and Laurence Pullar Part xii., The Lochs of the Lochy Basin (*Geogr Journ*, vol xxviii, pp 592-615; with 8 plates of maps)

[1] It is odd that surveys were apparently made of Lochs Arkaig, Lochy, and Ness about eighteen years ago by a German military officer named Sandler, who lived for some months in the district. The results of these surveys have never been published, but a copy of that of Loch Arkaig was obtained from Mr Honeyman, factor to Cameron of Lochiel, which corresponded very closely with the results of the Lake Survey

mile, and a mean breadth of half a mile covering an area of 1540 acres, and containing 13,907 million cubic feet of water, the maximum depth is 436 feet, and the mean

Photo] Fig. 2—Loch Lochy, from the southern end [James Chumley

depth 207 feet The loch forms a narrow triangle, broadest towards the south and tapering towards the outflow the steep slope of the hills being continued under water The basin is simple, all the contours approximately following the shore-line, but the line of greatest depth is nearer the western shore The 400-feet area is about two miles in length, the two ends approaching very close to the west side, where the steepest slopes occur The valley is so narrow relatively to the depth of the loch that, in the central parts, the steep slopes reach far towards the middle and leave comparatively little level bottom but towards the south end, where the loch is broader and not quite so deep, there is a greater extent of nearly flat bottom It is interesting to note that seiches were first observed by the staff of the Lake Survey in Loch Treig

Loch Ossian lies at an elevation of about 1270 feet above the sea to the north of Rannoch Moor, trending north-east and south-west with its long axis slightly curved, and of nearly uniform breadth throughout It is 3¼ miles long, and nearly half a mile in greatest breadth the mean breadth being one third of a mile The superficial area is nearly 660 acres, and the volume of water about 1224 million cubic feet the maximum depth 132 feet, and the mean depth 43 feet The lake-floor is very uneven, both the transverse and longitudinal sections being undulate

Loch Laggan situated between the Highland and West Highland Railways, the coach road from Kingussie to Tulloch passing along the northern shore, trends north-east and south-west, and is of the usual elongate narrow form of Scottish lochs, narrowest in the central parts and somewhat expanded towards each end where deeper water occurs, the outline is very irregular, and the bottom correspondingly irregular with a number of larger and smaller islands in the narrower parts It is more than seven miles in length two-thirds of a mile in maximum breadth, the mean breadth being nearly half a mile, and the superficial area about 1900 acres The maximum depth is 174 feet, the mean depth 68 feet, and the volume of water about 5600 million cubic feet The shallower contour lines are continuous, and follow approximately the outline of the shore, but all the deeper contours are much broken up There are four 75 feet areas and six 100 feet areas, the largest and deepest approaching the west end

Lochan na h-Earba is the name applied to two distinct lochs (now differing by nearly 10 feet in level though they may once have formed a single loch) lying in a valley running nearly parallel to and about 1 mile to the south of, that occupied by Loch Laggan The *west loch* is the larger and deeper of the two, nearly two miles long by one third of a mile in greatest breadth, covering an area of about 203 acres and containing 408 million cubic feet of water, with a maximum depth of 81 feet and a mean depth of 35½ feet The basin is simple, the contour lines being continuous, but narrowing more decidedly than the outline from the centre to each end, the slopes being much steeper towards the centre of the loch The *east loch* is about half a mile distant from the west loch, the stream conveying the overflow from the west loch winding through the boggy flat between them It is 1¼ miles long by a quarter of a mile in greatest breadth, covering an area of about 140 acres, and containing 101 million cubic feet of water, with a maximum depth of 69 feet and a mean depth of 31 feet The deep water is all towards the upper end the lower half being very shallow

Besides the larger lochs thus briefly summarised details are given in the paper of Loch Pattack the highest loch surveyed in the basin with a maximum depth of 58 feet and a mean depth of 14 feet, of Loch Ghuilbinn with a maximum depth of 49 feet and a mean depth of 13 feet, of an Dubh Lochan, a very small but relatively deep loch near Loch Treig

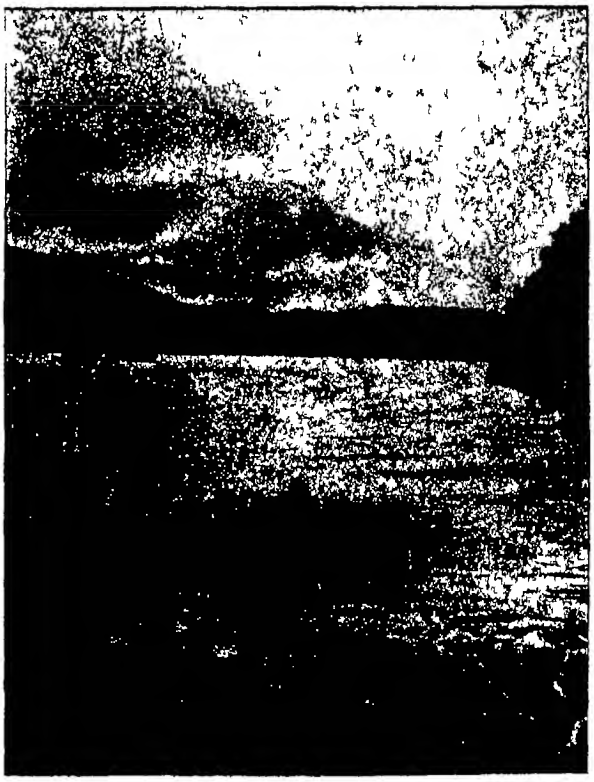


Photo James Chumley

Fig 3—Loch Arkaig, from the east end

with a maximum depth of 40 feet and a mean depth of 15½ feet, of Lochan Lunn dà Bhra with a maximum depth of 25 feet and a mean depth of 8¾ feet, and

of Loch nan Gabhar, a little weedy hollow only 5 feet deep, which is evidently being rapidly silted up. An interesting account is also given of the Red Lochan at Tulloch, a small pond lying in an extensive morainic terrace near the north end of Loch Treig, called in Gaelic by a name signifying "brown eye." It is only about 30 yards in longest diameter and 5 feet deep in the centre, fed only by rains and, though it has no outflow except by percolation through the gravel, its surface is maintained almost constantly at the same level. The water is always turbid and varies in colour from dull green to brown or red. When examined in May 1902, the water was brown, the collection with the coarse net was pale yellow, while that taken by the fine net was decidedly red; there were only two abundant organisms, the larva of an insect (Corethra) known as the "phantom larva," and a reddish-coloured rotifer, *Anuraea valga*, to which the colour of the water was evidently due, for none of the other organisms were abundant enough to be held responsible for the colour of the water. On placing the collections in formalin a blood-red sediment was deposited, which was found to consist chiefly of *Anuraea valga* and myriads of its red eggs. Examined subsequently at different seasons the changes of colour were doubtless correlated with the predominance of one or other organism. None of the other ponds in close proximity shared the turbidity and reddish-brown colour of the Red Lochan, the peculiarity being probably due to its being more closely shut in, the surrounding rim of gravel being 14 feet or more above the pond, and there is besides a fringe of birch trees. The water is stagnant, which favours the growth of certain organisms, particularly *Anuraea valga*. It is said that wildfowl never settle on the pond, and that the common frog cannot live in it. The following legend was related to Sir John Murray concerning this Red Lochan:—"Many centuries ago there lived in these parts a noted hunter named Donnuil. In return for some services rendered to the witch of Ben a Vreich, she offered to deprive the deer of the sense of sight or of smell so far as he was personally concerned. He chose to have the deer deprived of the sense of smell, 'for,' said he, 'I can easily cheat their eye.' The witch however told him that in the stomach of the last stag he would kill there would be found a ball of worsted thread. As time passed Donnuil became ill, and, while weak in bed, his daughter told him a fine stag was caught by the horns in some bushes near the house. He asked for his cross-bow, and although in bed he shot the stag through his bedroom window. Later on his daughter brought him a ball of worsted which had been found in the stomach of the stag. He knew his end was near; indeed, he died the same evening. On the following morning the Red Lochan had appeared at the place where the stag was killed."

The paper concludes with some interesting notes on the biology of the lochs by Mr. James Murray, who found that the plankton of Loch Lochy offered a remarkable contrast to that of Loch Ness, though the conditions seemed so similar, the quantity in Loch Lochy being many times greater and the species more numerous; but the special feature was the quantity and variety of the phytoplankton. In Lochan Lunn dà-Bhrà the Diaptomus was so deep red that when the nets were drawn from the water they seemed to contain blood; the same peculiarity was observed in An Dubh Lochan, but in a lesser degree.

The paper is illustrated by coloured maps showing the bathymetry and orography, and there are several woodcuts in the text, some of which are reproduced in this notice.

THE STRUCTURE OF METALS.[1]

THE lecturer said that his purpose was to give some account of researches in which he had been engaged for a good many years, dealing with the manner in which metals were built up and the manner in which their structures allowed them to yield when they were compelled to change their shape by being overstrained. A piece of metal was not a homogeneous single thing; it was a collocation of grains or granules, which built it up just as granules of ice built up a glacier. The grains of metal were irregular in shape and unequal in size. Their existence was revealed by polishing and etching the surface of the metal and examining it under the microscope, when the grains could readily be distinguished by differences of texture, and the boundaries between them could be clearly traced. Investigation showed that each grain was, in fact, a separate crystal, and the irregular boundaries were due to casual inequalities in the rates at which the various crystals had grown during their formation, which might occur when the metal was solidifying from a fluid state, or when it passed in the solid state through certain temperatures at which re-crystallisation took place. Each grain might be regarded as composed of an immense number of molecular brickbats grouped in perfectly regular tactical formation, but the direction in which these brickbats were piled was different in different grains; hence on being etched the polished surface showed differences in texture and in behaviour as to reflecting light. Microscopic photographs illustrating these features in iron and other metals were exhibited.

When the metal was strained beyond the elastic limit, and thereby compelled to change its form, the change of form took place by slips occurring between the layers of molecular brickbats in the individual granules. The discovery of these slips had been made by the lecturer in conjunction with Mr. Walter Rosenhain, by noticing certain lines to appear on the polished surface of a piece when subjected to severe strain. These lines, which they called slip lines, looked like minute crevasses, but were really steps caused by the slipping of one layer on its neighbours, just as cards might slip in a pack. In any one crystal grain there were at least three sets of independent parallel planes in which such slips could take place, and these allowed the grain to undergo complete alteration of form as a result of the straining. Microscopic photographs were exhibited showing three systems of slip lines on the surface, corresponding to slips in three directions throughout the substance of the grain. The true nature of these slip lines was made apparent by means of obliquely incident light, which showed them as little steps in the surface. An interesting direct confirmation of this had been afforded by recent experiments of Mr. Rosenhain, in which cross-sections of the stepped surface had been obtained.

Dr. Ewing next explained by aid of models, a theory which he had recently advanced as to the structure of the crystal granule itself. This theory might be regarded as an extension of the views he put forward fifteen years ago to explain the phenomena of magnetic induction by the mutual actions of polarised magnetic molecules. Cohesion in the crystalline structure might similarly be regarded as due to the mutual forces between polarised molecules, the polarity of which determined the regular tactical formation in which they grouped themselves to form the crystal. For this purpose he conceived of each molecule as possessing polarity along each of three rectangular axes, in other words, as having six poles exercising forces of attraction on the opposed poles of neighbouring molecules.

The lecturer proceeded by aid of the model, to demonstrate the process of crystal-building with these polarised molecules for brickbats. He showed how, under certain conditions, a group of dissenting molecules might be formed within the crystal grain possessing a certain degree of stability, though not in complete harmony with the molecules around them. Evidence for the existence of such groups was furnished by the microscope in the examination of iron and other metals. The process of straining was next considered, and it was shown that the conception of polarised molecules was in agreement with what was known of the actual behaviour of metals during, first, the elastic stage of straining, and, second, the stage where much greater yielding took place and permanent set was produced. The molecular theory explained how energy was dissipated in the process of straining, and also how elastic "fatigue" resulted. After any severe strain the piece was a long time in recovering its full amount of elastic quality, but the recovery could be accelerated by heating it. These phenomena were accounted for by

[1] Abstract of "Wilde" Lecture, delivered by Dr. J. A. Ewing, F.R.S., before the Manchester Literary and Philosophical Society on February 18.

the setting up of dissenting groups, as a result of straining, which resolved themselves after a time into the normal configuration. It further explained the fatigue of strength which was found to occur when a metal was subjected to repeated reversals of stress, a matter of great practical importance in the design of machines and engineering structures. The manner in which a piece broke, for example, after repeated bendings to and fro was discussed by aid of the molecular model. It was shown that the effects of slip are felt for some distance on either side of the plane of slip, a fatigued condition of the metal being established. This is especially the case when slip is many times repeated, backwards and forwards, and a condition is ultimately arrived at in which the cohesive bonds are broken and a crack results.

In conclusion, Dr. Ewing briefly referred to the relation between the molecular structure of the crystal grain, to which strength and elasticity were to be ascribed, and the finer structure which accounted in magnetic metals for the phenomena of magnetism. He had formerly shown that in the process of magnetisation in iron there was a turning round of a molecular axis possessing magnetic polarity. It was when the magnetically polar axes of all the molecules were turned round so as to face one way that the iron became "saturated." The polarity he was now concerned with was different in kind. It was not magnetic, and it existed in three directions, whereas the magnetic polarity with which the process of magnetisation was concerned was uniaxial. Moreover, the three-directional polarity concerned in crystal building did not suffer rotation when a magnetising force was applied. We had accordingly to think of the molecule as possessing polar axes which were non-magnetic and remained fixed under the control of forces of the same kind exerted by the poles of neighbouring molecules, and at the same time as possessing an inner structure characterised by uniaxial magnetic polarity, which was capable of rotation under the influence of an applied magnetising force while the non-magnetic polar axes remained fixed.

FORTHCOMING BOOKS OF SCIENCE.

MESSRS. BAILLIÈRE, TINDALL AND COX direct attention to:—"Practical Agricultural Chemistry," by F. Robertson; "Meat Inspection," by Dr. W. Robertson; "Blood Stains (a Medico-legal Book)," by Major Sutherland; "Trypanosomata and the Trypanosomiases," by A. Laveran and F. Mesnil, translated and edited by Dr. D. Nabarro; and a new edition of "The Röntgen Rays in Medical Work," by Dr. D. Walsh, with section on apparatus and methods by Dr. L. Jones.

Messrs. A. and C. Black announce:—"Notes upon the Island of Dominica (British West Indies)," by S. Grieve, illustrated; "Rudolf Eucken's Philosophy of Life," by W. R. B. Gibson; "The Sense of Touch in Mammals and Birds, with Special Reference to the Papillary Ridges," by Dr. W. Kidd; "How to Fish," by W. E. Hodgson; "Man, his Manners and Customs," by L. W. Lyde; and "Descriptive Geography of the British Isles," by F. D. Herbertson.

Messrs. William Blackwood and Sons promise:—"In the Footsteps of Marco Polo, being the Account of a Journey Overland from Simla to Pekin," by Major C. D. Bruce; "The Sovereignty of the Sea: an Historical Account of the Claims to the Exclusive Dominion of the British Seas and of the Evolution of the Territorial Waters, with Special Reference to the Rights of Fishing," by Dr. T. W. Fulton; "In Malay Forests," by G. Maxwell; and "Forest Entomology," by A. T. Gillanders.

In Messrs. Cassell and Co.'s list we find:—"Greenhouses and Conservatories, Constructing and Heating"; "Steel, its Varieties, Properties, and Manufacture"; "Domestic Hot Water Supply"; "Iron, its Sources, Properties, and Manufacture"; "Photographic Studios and Dark Rooms"; "Window Blinds"; "Tinplate Work"; "Rustic Carpentry"; "Pumps and Rams, their Action and Construction"; "Domestic Jobbing"; and "Zinc Working."

Messrs. Chatto and Windus give notice of:—"A History of Sumer and Akkad, being an Account of the Primitive Inhabitants of Babylonia, with Maps and Illustrations after all the Principal Monuments of the Period in the British Museum and Elsewhere, and a Special Binding Design after a Monument of the Period," by L. W. King; and "The Paradise or Garden of the Holy Fathers, being Histories of the Anchorites, Recluses, Cœnobites, Monks, and Ascetic Fathers of the Deserts of Egypt between A.D. CCL and A.D. CCCC circiter, compiled by Athanasius, Archbishop of Alexandria; Palladius, Bishop of Helenopolis; Saint Jerome, and others, now translated out of the Syriac, with Notes and Introduction," by Dr. E. A. W. Budge.

Messrs. Archibald Constable and Co., Ltd., announce:—"European Animals, their Geological History and Geographical Distribution," by Dr. R. S. Scharff; "Natives of Northern India," by W. Crooke; "Universal Dictionary of Mechanical Drawing," by G. H. Follows; "Railroad Curve Tables for the Field Engineer," by R. S. Henderson; "Cranes," by A. Böttcher, translated from the German, enlarged, and edited with a complete description of English and American practice by A. Tolhausen; "Searchlights," by F. Nerz, translated from the German by C. Rodgers; "Agglutinants and Adhesives," by H. C. Standage; "Irrigation, its Principles and Practice as a Branch of Engineering," by Sir H. Brown; "Design of Irrigation Works," by W. Bligh; "Experimental and Theoretical Applications of Thermodynamics to Chemistry," by Prof. W. Nernst; "The Elastic Arch, with Reference to the Reinforced Concrete Arch," by B. R. Leffler; "Machine Design," by C. H. Benjamin; "A Text-book of Hydraulics, including an Outline of the Theory of Turbines," by L. M. Hoskins; "Fuel, Water, and Gas Analysis," by J. B. Kershaw; "Gas, Oil, and Solid Fuel," by Prof. V. B. Lewes; "Gold and Precious Metals," by Dr. T. K. Rose; "Electrometallurgy," by J. B. C. Kershaw; "Electrical Distribution of Power," by J. H. Davis; "Gas Light and Heating," by W. H. Y. Webber; "Coal," by J. Tonge; "Iron and Steel," by J. H. Stansbie; "The Manufacture of Paper," by R. W. Sindall; "India-rubber and Gutta-percha," by H. L. Terry; "Wood Pulp and its Applications," by C. F. Cross, E. J. Bevan, and R. W. Sindall; "Steam Engines," by J. T. Rossiter; "Glass," by W. Rosenhain; "Electric Lamps," by M. Solomon; "Steam Locomotives," by V. Pendred; "Patents, Trade Marks, and Designs," by K. R. Swan; and "Photography," by A. Watkins.

Messrs. J. M. Dent and Co.'s list includes:—"Nature-study," by Prof. J. R. A. Davis; "Trigonometry," by C. Hawkins; "Fly-fishing," by Sir E. Grey, illustrated; "Our Gardens," by the late Dean Hole and G. S. Elgood; and "Farming," by W. M. Tod, illustrated.

Messrs. Duckworth and Co. announce:—"The Interpretation of Nature in Earlier Greek Art," by E. Löwy, translated and illustrated; and a new edition of "A Text-book of Plant Diseases," by G. Massee.

In Messrs. Everett and Co.'s list appears:—"Charts of the Diseases of the Horse, with Explanatory Notes and Prescriptions," by C. Gresswell.

Mr. Gustav Fischer (Jena) will publish:—"Die Bakteriologie des Auges," by Prof. Axenfeld, illustrated; "Das Dysenterietoxin," by Dr. R. Doerr, illustrated; "Geologische und Palaeontologische Abhandlungen," edited by E. Koken, Band viii., Heft iii., illustrated; "Die Grosshirnrinde des Menschen in ihren Massen und in ihrem Fasergehalt," by Dr. T. Kaes, i Teil, text, 2 Teil, illustrations; "Praktikum der Bakteriologie und Protozoologie," by Drs. K. Kisskalt and M. Hartmann; "Jahresbericht der Literatur über physische Anthropologie im Jahre 1905," by Dr. E. Fischer, edited by Dr. G. Schwalbe; "Normentafeln zur Entwickelungsgeschichte der Wirbeltiere," edited by Prof. F. Keibel, Siebentes Heft: "Normentafel zur Entwickelungsgeschichte des Koboldmaki (Tarsius Spectrum) und des Plumplori (Nycticebus Tardigradus)," by Prof. A. A. W. Hubrecht and F. Keibel, illustrated; "Progressus rei Botanicae: Fortschritte der Botanik; Progrès de la Botanique; Progress of Botany," edited for the International Association of Botanists by Dr. J. P. Lotsy, Erster Band, Zweites Heft; "Verhandlungen der deutschen pathologischen Gesellschaft," Zehnte Tagung gehalten in Stuttgart vom September 17-21, 1906,

Jahrgang 1906, illustrated, "Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia* 1898–1899," Funfzehnter Band, 1 Lieferung, die Tiefsee Fische by Prof A Brauer, Systematischer Teil, illustrated "Zoologische Forschungsreisen in Australien und dem Malayischen Archipel," by Prof R Semon Dritter Band, Monotremen und Marsupialier II, 2 Teil 3 Lieferung, illustrated, and "Klinisches Jahrbuch," Sechzehnter Band, Zweites Heft illustrated

Mr H Frowde promises —"Australasia," by J D Rogers, being the sixth volume of the "Historical Geography of the British Colonies", "The Dillenian Herbaria an Account of the Dillenian Collections in the Herbarium of the University, together with a Biographical Sketch of Dillenius, Selections from his Correspondence, Notes &c" by G C Druce, edited, with an introduction, by Prof S H Vines, F R S, "Ancient Khotan" detailed Report of Archaeological Exploration in Chinese Turkestan, carried out and described under the Orders of H M Indian Government by M A Stein, 2 vols, and "Surgical Instruments in Ancient Times," by J S Milne

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Mr W Heinemann's list contains —"A Handbook of Metabolism" by Prof C von Noorden, English translation edited by Dr I W Hall 3 vols, "The Nutrition of Man" by Prof R H Chittenden, illustrated, "The World's History a Survey of Man's Record," edited by Dr R F Helmolt vol v, "Eastern Europe" "Eclipse and O'Kelly" by T A Cook, illustrated and "Wild Flowers of the British Isles," written by H I Adams illustrated

Messrs Hodder and Stoughton promise —"Brain and Personality or the Physical Relations of the Brain to the Mind" by Dr W H Thomson, illustrated, and "The Book of the Open Air," by F Thomas, twelve monthly parts, illustrated

The list of Messrs Hutchinson and Co contains —"Extinct Birds" by the Hon W Rothschild, illustrated "The World's Peoples," by Dr A H Keane, illustrated, "In Wildest Africa," by C G Schillings, translated by F Whyte, 2 vols, illustrated, "Nearest the Pole," by Commander R E Peary illustrated, and "Maori and Polynesian," by J M Brown

Messrs P S King and Son direct attention to —"The Infant the Parent, and the State a Social Study and Review," by H L Heath and "Central Poor-law Conference, 1907, Report of the Proceedings of the Central Poor-law Conference held on February 19 and 20 at the Guildhall London", "Poor-law Conferences, 1906–7, Annual Volume containing the Reports of the Proceedings of the Central and District Conferences held from May, 1906, to February, 1907, with the Report of the Central Committee"

Mr John Lane's list contains —"Ornithological and other Oddities," by F Finn, illustrated, "Forms of Paralysis," by Dr J S Collier; "The Post-mortem Handbook," by Dr C R Box, "Minor Operations," by E M Corner, "Book of Rock and Water Gardens," by C Thonger, "The Book of the Chrysanthemum," by P S Follwell, "The Book of Fruit Bottling," by E Bradley and M Crooke, and a new edition of "The Tree Book," by M R Jarvis

Messrs Crosby Lockwood and Son give notice of —"Modern American Lathe Practice," by O E Perrigo, illustrated, "Graphical Handbook for Reinforced Concrete Design," by J Hawkesworth, with an appendix containing the requirements of the Building Code of New York City *in regard to reinforced concrete, illustrated*, "The Construction of Dynamos (Alternating and Direct Current), a Text-book for Students, Engineer-constructors, and Electricians-in-charge," by T Sewell, illustrated, "A Handbook of Wireless Telegraphy its Theory and Practice, for the Use of Electrical Engineers, Students, and Operators," by Dr J Erskine-Murray, illustrated, "The Twentieth Century Book of Recipes, Formulas, and Processes containing nearly 10,000 Selected Scientific, Chemical Technical, and Household Recipes, Formulas and Processes, for Use in the Laboratory, the Office the Workshop and the Home," edited by G D Hiscox, illustrated, and new editions of "Mechanical Engineer's Pocket-book of Tables, Formulæ, Rules, and Data, a Handy Book of Reference for Daily Use in Engineering Practice," by the late D K Clark, revised by H H P Powles, and "A Handybook for Brewers, being a Practical Guide to the Art of Brewing and of Malting," by H F Wright, illustrated

Messrs Longmans and Co's announcements include —"Design in Nature, illustrated by Spiral and other Arrangements in the Inorganic and Organic Kingdoms as exemplified in Matter, Force, Life Growth Rhythms &c, especially in Crystals Plants, and Animals," by Dr J B Pettigrew, F R S, illustrated, "Nature Round the House, a Simple Natural History for Small Students," by P Wilson, illustrated, "Hydraulics," by Prof S Dunkerley, 2 vols "Electro physiology of Plants," by Prof J C Bose, illustrated, "Investigation on the Theory of the Photographic Process," by Drs S E Sheppard and C E K Mees, "The Teaching of Mathematics in the Elementary and the Secondary School," by Dr J W A Young, and "Systematic Researches in Thermo-chemistry Numerical and Theoretical Results," by J Thomsen, translated by K A Burke

In the list of Messrs Macmillan and Co, Ltd, are to be found —"Inflammation," by Prof J G Adami, F R S, "Mining Tables" by Hatch and Valentine, "Geometry Papers," by R Deakin, "Steam and Other Engines," by J Duncan, and new editions of "Modern Views of Electricity," by Sir Oliver Lodge, F R S, "A Hunter's Wanderings in Africa," by F C Selous; and "Woolwich Mathematical Papers," edited by E J Brooksmith

Mr Elkin Mathews directs attention to —"The Days of a Year a Naturalist's notes from January 1 to December 31" "the Harvest of a Quiet Eye."

Mr Murray's list includes —"Life and Adventures of Captain Cook, R N, the Great Circumnavigator of the World," by A Kitson, illustrated, "Cretan Excavations and their Bearing on Early History," by Prof R M Burrows "Heredity," by Prof J A Thomson, "Recent Development in Biological Science," by W B Hardy F R S, "A Primer of Psychology," by L Brackenbury, "Notes on the Teaching of Elementary Chemistry, with a Sequence of Experiments on Air and Combustion," by J B Russell (teacher's edition)

Messrs A Owen and Co announce —"The Moon in Modern Astronomy," by P Fauth.

Messrs George Philip and Son, Ltd., will publish —"A New Physical Geography for Intermediate and Secondary Schools" by E O Williams, and "Builders of the Body," by E Miles

Sir Isaac Pitman and Sons, Ltd, give notice of new editions of "Great Astronomers," "In Starry Realms,"

and "In the High Heavens," three works by Sir R S Ball, F.R.S.; "Astronomy for Everybody," by Prof S Newcomb, with an introduction by Sir R S Ball, "By Land and Sky, the Record of a Balloonist," by Rev J. M Bacon, "Minute Marvels of Nature," by J. J Ward, and "Peeps into Nature's Ways," by J J Ward.

Messrs G P. Putnam's Sons' list contains —"The Family, an Ethnographical and Historical Outline, with Descriptive Notes, planned as a Text-book for the Use of College Lecturers and Directors of Home-reading Clubs," by Dr E L. Parsons, "Hunting Big Game with Gun and with Kodak how Wild Animals Look and Live in their Haunts, from Personal Experiences in the United States, Dominion of Canada, and Old Mexico," by W S Thomas, illustrated; "On the Great American Plateau, Wanderings among Canyons and Buttes in the Land of the Cliff Dweller, and the Indian of To-day," by T M Prudden, illustrated, "Diagnosis of Organic Nervous Diseases," by Dr C A. Herter, revised by Dr L P Clark, illustrated, "The Sporting Rifle," by W Winans illustrated; "Scientific Sanction for the Use of Alcohol," by Dr. J Starke; "The Muscles of the Eye," by Dr L. Howe, 2 vols; "Philosophical Problems in the Light of Vital Organisation," by E Montgomery, and a new edition of "A Manual of Prescription Writing, with a Full Explanation of the Methods of Correctly Writing Prescriptions, and Rules for avoiding Incompatibilities and for Combining Medicines," by Dr M D Mann

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Messrs Smith, Elder and Co give notice of —"Animal Life," by Dr F. W Gamble, illustrated, and "The South Polar Times," reproduced in facsimile, the periodical brought out by the officers of the National Antarctic Expedition on board the *Discovery* during the Antarctic winters of 1902 and 1903, illustrated

Messrs. Swan Sonnenschein and Co, Ltd, direct attention to —"How to Study Geology," by E Evans, and a new edition of "Life by the Sea-shore, an Introduction to Natural History," by Dr M Newbigin

Messrs E and F N. Spon, Ltd, announce —"The Smith and Forgeman's Handbook of Practical Smithing and Forging," by T Moore, "English Weights, and their Equivalents in Kilogrammes," by F W A Logan, "The Stoker's Catechism," by W J Connor "A Treatise on the Grouping of Electric Cells," by W F Dunton "Experimenting with Induction Coils," by H S Norrie, "Mechanical Draft, a Practical Handbook for Engineers and Draftsmen," by J H Kenealy, "Types and Details of Bridge Construction," by F W Skinner, part ii, "Plate Girders", "Designs for Small Dynamos and Motors," by C P Poole, and new editions of "A Treatise on Surveying," compiled by R E Middleton, O Chadwick, and J Du T Bogle, part ii and "The Management of Electrical Machinery," by F B Crocker and Dr S. S. Wheeler

Mr Edward Stanford announces —Vol i of "Australasia" in Stanford's "Compendium of Geography and Travel," by Prof J. W Gregory, F R S illustrated

Mr Elliot Stock promises —"Natural History of the British Butterflies," by J. W Tutt, vol i, illustrated

The University Tutorial Press, Ltd, will issue — "Plant Biology," by Dr F. Cavers, and a new edition of "Physiography," by Drs R W Stewart and W Briggs.

Mr Fisher Unwin's list contains —"Woodlanders and Field Folk," by J Watson, "The Birds of Middlesex," by J. E. Harting, illustrated, "The Psychology and Training of the Horse," by Count E M Cesaresco, "The Principles and Practice of X-Ray Diagnosis and Therapy," by Dr J Rudis-Jicinsky, with the collaboration of C H Treadwell and Dr J Hoffman, illustrated, and "The Horse, a Pictorial Guide to its Anatomy," 110 drawings (reproduced by photolithography) by H Dittrich, with explanatory notes by Profs Ellenberger and Baum

Messrs Watts and Co announce —"An Essay Outline of Evolution," by D Hird

The following are Messrs Whittaker and Co.'s announcements —"Modern Practice of Coal Mining" by D Burns and G L Kerr, "Armature Construction," by H M Hobart and A G Ellis, "Electricity in Mining," by P R Allen, "Electric Lamps and Photometry," by L Gaster, "Motor-car Construction," by T Gray, "The Care of Motor Cars," by T Gray, and "An Advanced Text-book of Steam, Gas, and Oil Engines," by J W Hayward

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD —The master and fellows of University College have established a "Radcliffe prize" for the encouragement of research in medical science, it will be awarded every second year alternately with the Rolleston prize Its value is 50*l*, and it is open to all graduates who have not exceeded twelve years from the date of passing the last examination for the degree of Bachelor of Arts and are not Radcliffe fellows at the date of application Candidates must send in their memoirs to the secretary to the boards of faculties on or before June 1

CAMBRIDGE —The Master of Trinity Hall has consented to act, and will be formally appointed to act as deputy for the Vice-Chancellor for the period from March 22 to April 24, when the Vice-Chancellor will be absent in America representing the University at the opening of the Carnegie Institute

The subject selected for the Adams prize in 1908 is "The Radiation from Electric Systems or Ions in accelerated Motion and the Mechanical Reactions on their Motion which arise from it" The prize is open to the competition of all persons who have at any time been admitted to a degree in this University The essays must be sent in to the Vice-Chancellor on or before December 16 1908, privately The successful candidate will receive about 225*l*

A university lecturer in pathology will shortly be appointed The stipend is 100*l* per annum Candidates are requested to send their names and testimonials to the Vice Chancellor on or before April 19

The next combined examination for sixty-six entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's Jesus, Christ's, St John's, and Emmanuel Colleges will be held on December 3 and following days Mathematics and natural sciences will be the subjects of examination at all the above-mentioned colleges A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1907 Forms of application for admission to the examination at the respective colleges, and further information respecting the scholarships may be obtained as follows —Pembroke College, Mr W S Hadley, Gonville and Caius College the Master, King's College, Mr W H Macaulay, Jesus College Mr A Gray, Christ's College, Rev J W Cartmell, St John's College, Dr J. R Tanner, Emmanuel College, the Master

DR H T BARNES, assistant professor of physics in McGill University, Montreal, has been appointed professor of experimental physics in succession to Prof E Rutherford, F R S

THE sixth annual students' soirée of the Sir John Cass Technical Institute will be held on Saturday, March 16. The programme includes special demonstrations and short addresses on scientific subjects in the laboratories and workshops of the institute.

ON April 23 the University of Glasgow will confer the honorary degree of Doctor of Laws upon Sir George Watt, author of the "Dictionary of the Economic Products of India"; Prof. E. Boutroux, Paris; Prof. J. Norman Collie, F.R.S.; Prof. U. Dini, Pisa; Prof. J. H. Poincaré, Paris; Prof. John G. McKendrick, F.R.S.; and Principal D. Macalister.

THE estimated expenditure on education, science, and art for the year ending March 31, 1908, is given in the Civil Service Estimates, recently issued, as 17,495,237*l*, which is a net increase of 310,955*l* upon the grants made in the fiscal year just ending. The following extracts show how some of the estimates compare with the grants made in the preceding year:—

	1507 8	Compared with 1906-7 Increase	Decrease
	£	£	
Board of Education	13,593,646	254,046	—
British Museum	171,041	1,043	—
Scientific Investigation, &c.	54,479	—	3,171
Universities and Colleges, Great Britain, and Intermediate Education, Wales	201,400	1,000	—
Public Education (Scotland)	2,022,554	50,426	—
Public Education (Ireland)	1,408,360	15,137	—
Queen's Colleges (Ireland)	4,700	—	161

The apparent decrease in the estimate under scientific investigation is explained by the fact that in 1906-7 the grant to the National Physical Laboratory for new buildings and equipment was 10,000*l*, instead of the 5000*l* to be granted to the laboratory in 1907-8.

THE executive committee has submitted to the trustees of the Carnegie trust for the universities of Scotland its sixth annual report, which is concerned with the administration of the trust during the year 1906. Under the scheme of allocation for five years of an annual grant of 40,000*l* among the four Scottish universities, which became operative on January 1, 1903, sums of 37,280*l* were claimed and paid during 1906. The grants for library purposes and for provisional assistance in teaching amounted for the year to 6400*l*. For buildings and permanent equipment the grants for 1906 reached 26,189*l*. Payments towards teaching endowments to the extent of 4700*l* were made, and there is under this head an unexpended balance of 25,132*l*. Under the scheme of endowment of post-graduate study and research appointments were made to seventeen fellowships and to thirty-seven scholarships. Grants of varying amounts were in addition paid to forty applicants. The total expenditure under this scheme was 6,903*l* during 1906, and it is estimated that during 1907 8094*l* will be spent. The expenditure upon the Royal College of Physicians laboratory during the year was, so far as the trust is concerned, 314*l*—this amount being independent of the capital invested in taking over the property of the laboratory buildings. The report directs attention to modifications in the scheme of payment of class fees adopted last year by the committee, the first limited payment of fees of further classes to those beneficiaries who had passed their graduation examinations up to date, and the second modification limited payment of fees of advanced classes to those who had proved their ability to profit by such classes. A striking diminution in the number of beneficiaries and in expenditure upon class fees followed the adoption of these modifications. The report is provided with extensive appendices which supply detailed information concerning the numerous activities of the trust.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13, 1906.—"The Velocity of the Negative Ions in Flames." By Ernest Gold. Communicated by Prof. H. A. Wilson, F.R.S.

The experiments described in this paper may be regarded as a continuation of the investigations of the properties of ions in flames carried out by Prof. H. A. Wilson in this country and by Marx and Moreau on the Continent.

The determinations of the velocity of the negative ions previously made had led to the conclusion that the ions were of the nature of corpuscles loaded with electrically neutral molecules. The present series of experiments shows that this is not the case, but that the ions are probably free electrons.

The first part of the paper gives an account of experiments made with platinum disc electrodes immersed in a flame obtained by burning the gas from a large Bunsen burner at a row of holes in a quartz tube (quartz for insulation). It is shown that the conductivity of the flame is unaffected by putting salt on the electrodes, although the current is increased from $7{\cdot}3 \times 10^{-4}$ to 261×10^{-4} ampere, a result which enables the gradient to be determined from the current.

The value of the conductivity obtained and the number of ions per c.c. deduced from experiments by Prof. Wilson and the author (*Phil. Mag.*, April, 1906) enable an approximate value to be found for the velocity of the negative ions in an electric field. The velocity so obtained, 8000 cm. per second for an intensity of one volt per cm., was of a different order from those previously obtained (1000 cm. per sec.).

The latter had been found on the assumption that for small potential differences between platinum electrodes the gradient in the flame was uniform from electrode to electrode, the very close way in which Ohm's law was followed for small applied E.M.F.'s serving as a foundation for the assumption. The measurement of the gradient for applied E.M.F.'s of the order of one volt across 5 cm. is complicated by the variations in the potential taken up by a platinum wire in the flame due to changes in the temperature and ionisation. These changes are large compared with the quantities to be measured, and ordinary methods of deducing corrections leave possible errors of the same order as the corrected quantity. To avoid this difficulty a special arrangement was adopted, in which, by using a thermocouple as explorer, the actual variations due to the applied E.M.F.'s were separated from the incidental variations in the flame. It was found in this way that the fall of potential consisted of a rapid drop at the electrodes, at the negative electrode for the free flame, and at the positive when salt was vaporised beneath the kathode, together with a uniform gradient in the body of the flame.

The results so obtained gave the gradient necessary to drive the ions of salt vapour from the kathode to the anode while they travelled upwards with the stream of gas.

If v is the upward velocity of the flame gases, h the height of the electrodes, d the distance between them, and x the distance the salt vapour extends from the kathode, the velocity k of the negative ions for unit electric field is given by $k X/d \quad x=v/h$, where X is the gradient found as above. The velocity v of the flame gases was found by photographing the images of bright particles in the flame formed by reflection at a plane mirror attached to an electrically-driven tuning-fork.

The value found for the velocity of the negative ions for a gradient of one volt per cm. was found to be 12,900 cm. per sec.

The velocity of a corpuscle of mass m and charge e in an electric field of intensity X is $Xe\lambda/mu$, where λ is the mean free path and u the mean velocity of agitation of the corpuscles. Taking for e/m, λ, u, the values 10^7, 3×10^{-4}, $2{\cdot}32\times10^7$ respectively, we get for a field of one volt per cm. a value 13,000 cm. per sec. nearly, a result in close agreement with the value for the velocity of the ions found experimentally. It appears therefore that the

negative ions in flames are free electrons, and not atoms or loaded corpuscles

Interesting results, suggesting a field for further investigation, were found for the gradient when salt was vaporised beneath both electrodes

January 24.—"On a New Iron Carbonyl and on the Action of Light and Heat on the Iron Carbonyls" By Sir James **Dewar**, F R S, and Dr H O **Jones**.

The paper contains an account of the extension of the experiments, previously described, on the action of light on the liquid iron pentacarbonyl and on the action of heat on the resulting solid compound, diferrononacarbonyl In the course of the experiments, new and interesting observations were made, and a new compound of iron and carbon monoxide discovered

The action of light on iron pentacarbonyl alone or in solution results in the formation of $Fe_2(CO)_9$ and carbon monoxide, except in two cases, (1) when the solvent is nickel carbonyl, and (2) when the temperature is above 56° C

The absence of any action due to light above 56° C has been confirmed by using tubes fitted with a small manometer, which showed no change of pressure when no solid was deposited, and showed that the deposition of solid was a delicate test for any action

At 35° C solid was deposited, and pressure developed in five minutes in sunlight

At 45° C to 50° C solid was deposited, and pressure developed in thirty minutes in sunlight

At 56° C *no* solid was deposited, and *no* pressure developed in five to twelve hours in sunlight

The velocity of the reaction was measured, and it was found to be a reaction of the "first order" The rate of decomposition was compared with the rate of the reaction between ferric chloride and oxalic acid, which was investigated by Lemoine, it was found that iron carbonyl was slightly more sensitive to light than the mixture used by Lemoine

The rate of the reverse action of carbon monoxide on the solid, which takes place in the dark was also measured, and was found to be very small at the ordinary temperature, but to have a fairly normal temperature coefficient, the velocity was approximately trebled for an increase of 10° C

Thus a reasonable explanation of the absence of any action of light above 56° C can be suggested If the direct action induced by light has a very small temperature coefficient, as the reaction investigated by Lemoine has, the reverse action being about 240 times as rapid at 56° C as at 16° C would easily prevent the accumulation of appreciable quantities of the products of the decomposition

The action of heat on diferrononacarbonyl alone has been shown to produce a decomposition represented by the equation $2Fe_2(CO)_9 = 3Fe(CO)_5 + Fe + 3CO$. When the solid was heated in the presence of hydrocarbons ether bromobenzene, or iron pentacarbonyl however, *green* solutions were obtained, iron pentacarbonyl was produced, but no gas was evolved, if alcohol, pyridine, acetone, or acetonitrile was the liquid used, *red* solutions were obtained, but no gas was evolved with nickel carbonyl as solvent, gas was evolved and iron deposited From the green solutions, under suitable conditions lustrous green crystals were deposited, these were found to be a new compound *iron tetracarbonyl*, $x\{Fe(CO)_4\}$, where x is large, probably about 20

The new compound has a molecular volume of 84 for the unit $Fe(CO)_4$ and is very stable It is not decomposed by hot concentrated hydrochloric acid, is attacked by hot concentrated sulphuric acid giving carbon monoxide and *ferrous sulphate*, and is readily decomposed by cold nitric acid

Iron tetracarbonyl dissolves in hydrocarbons, ether, iron pentacarbonyl, nickel carbonyl acetone, and acetonitrile to give green solutions which do not change on heating for a short time, and which deposit the green compound unchanged when evaporated out of contact with air in pyridine and alcohol the compound dissolves to give a green solution, which changes slowly in the cold and rapidly on heating into a red solution

The green solutions exhibit a characteristic absorption band in the yellow while the red solutions show no selective absorption

Chemical Society, February 21 —Prof R **Meldola**, F R S, president, in the chair —The constitution of hydroxyazo-compounds W B **Tuck**. Several of the hydroxyazo-compounds were examined spectrographically and it was found that the absorption spectra of the *p*-hydroxy-compounds agree closely with those of their derivatives The ethers of *o*-compounds also agree with the *p*-compounds, but the benzoyl derivatives are similar to benzoquinonebenzoylphenylhydrazone —The influence of solvents on the rotation of optically active compounds, part ix, a new general method for studying intramolecular change T S **Patterson** and A **McMillan** —Displacement of halogens by hydroxyl, i, the hydrolytic decomposition of hydrogen and sodium monochloroacetates by water and by alkali, and the influence of neutral salts on the reaction velocities G **Senter** On the basis of the results obtained, the hypothesis put forward by R J Caldwell, that the accelerating influence of neutral salts on certain catalytic actions is due to the withdrawal of water and consequent concentration of the reacting substances, was criticised It is considered that the effect in question is due to the action of the ions of the salt on H' and OH' ions —The interaction of ammonium salts and the constituents of the soil A D **Hall** and C T **Gimingham** —The reduction products of *o*- and *p*-dimethoxybenzoin J C **Irvine** and Miss A M **Moodie** —Constituents of natural indigo, part ii A G **Perkin** Numerous Java indigos have been found to contain kampferol The leaves of *Indigofera sumatrana* contain a trace of what is probably kæmpferol —The velocity of hydrolysis of aliphatic amides J C **Crocker** —The rates of reaction of formamide, acetamide, propionamide butyramide isobutyramide, valeramide, capronamide with hydrochloric acid, have been determined at from 40° to 80° The reactions are bimolecular, and the order of the relative reactivities is the same for each temperature A relation between the reactivity of the amides at constant temperature and the strength of the corresponding organic acids was indicated —The rusting of iron W R **Dunstan** In order to explain the fact that the rusting of iron can take place in the absence of carbonic acid and that only iron, oxygen, and liquid water are necessary, the working hypothesis was suggested that the formation of hydrogen peroxide is concerned in the change, rusting being prevented by those substances which are capable of decomposing the peroxide (Trans Chem Soc, 1905 lxxxvii, 1548) The results of further experiments carried out by the author show that iron rusts freely in the absence of carbonic acid, provided that iron, oxygen, and liquid water are brought together —Contributions to the chemistry of the rare earths, part ii M **Esposito**. The methods of Muthmann and Böhm and Pattinson and Clarke for the preparation of ceria have been found to give a fairly pure product Lanthana and old didymia can be separated by fractional crystallisation of the oxalates from strong nitric acid Lanthana is best obtained by fractional crystallisation of the double ammonium nitrates After one hundred and ten fractionations, lanthana praseodymia, and neodymia were obtained in a state of considerable purity —Derivatives of multivalent iodine, part iii, action of heat on iodobenzene dichloride and on the *m* and *p*-nitro- and *p*-chloro-derivatives W **Caldwell** and F A **Werner** —The organic phosphorus compound formed by yeast-juice from soluble phosphates Preliminary notice W J **Young** A lead salt of the compound was prepared from the fermentation mixture by first removing any free phosphate by magnesium nitrate, and then adding lead nitrate Analyses of two preparations, in which the carbon hydrogen lead and phosphorus were determined gave the empirical formula $C_3H_5O_6PPb$ From a solution of this the free acid can be obtained which reduces Fehling's solution, gives Mohlisch's a-naphthol reaction is slightly dextrorotatory, and can be titrated with alkalis —Experi

ments on the synthesis of the terpenes, part x, synthesis of carvestrene and its derivatives W H **Perkin**, jun, and G **Tattersall** Continuing their work on the synthesis of carvestrene, the authors have prepared *m*-cineol by the action of magnesium methyl iodide on ethyl *cyclo*-hexanone-3-carboxylic acid, and the *cis*- and *trans*- modifications of *m* menthane-1 8-diol have also been obtained

Zoological Society, February 19 —Sir Edmund G Loder, Bart, vice-president, in the chair —Remains of a bear from the superficial deposits of a cavern in the mountains of Corsica, where bears, though now extinct, were formerly numerous, at least up to the sixteenth century Dr C I Forsyth **Major** Despite the fact that no truly fossil bears were as yet known from Corsica, Dr Forsyth Major considered the Corsican bear to have been autochthonous, whilst in his opinion the recent mammals of Corsica (and Sardinia) had been, almost without exception, introduced by human agency In any case, they could not be adduced as proofs of a recent connection of those islands with either of the neighbouring continents —English domestic cats R I **Pocock**. The author urged that the surest basis for their classification and the most satisfactory clue to their descent was furnished by the two distinct patterns found in so-called tabby cats In one type the pattern consisted of narrow vertical stripes, in the other of longitudinal or obliquely longitudinal stripes which, on the sides of the body, tended to assume a spiral or subcircular arrangement characteristic of the "blotched" tabby This distinction was long ago pointed out by Blyth One or the other of these types was to be found in cats of almost all breeds, whether "Persian," "short-haired," or "Manx" There appeared to be no intermediate stages between the two The cats of the "striped" type were no doubt descended from the European wild cat and the North African wild cat, but the origin of cats exhibiting the "blotched" pattern appeared to be unknown It was to the cat of the latter kind that Linnaeus gave the name *catus*, which was therefore no longer available for the European wild cat, this cat, therefore, must take the name *sylvestris* —Report on the deaths that occurred among the mammals and birds in the society's menagerie during 1906 Dr C G **Seligmann** 356 Mammals and 283 birds were submitted to *post-mortem* examination, and the results showed that (1) tuberculosis occurring in birds in the gardens was usually due to infection by the gut (2) the hearts of rheas, cassowaries, ostriches, and some of the larger storks kept in the gardens were often extremely flabby, and death in these birds was in a large number of cases due to cardiac failure (3) new growths were rare both in mammals and in birds, but one case of carcinoma arising in the kidney, and occurring in a Chilian pintail (*Dafila spinicauda*), had been observed, as well as two instances of benign new growths occurring in birds not inmates of the gardens —A peculiarly abnormal specimen of the turbot J T **Cunningham**. The specimen was captured near Padstow, on the north coast of Cornwall It was a young fish, measuring only 4 4 cm in length and a normal specimen of slightly smaller size, taken at the same time was completely metamorphosed to the asymmetrical condition of the adult In the abnormal specimen the right side was almost entirely destitute of colour as in the normal condition but both eyes were on this white side instead of being on the left side, as in normal turbot On the left side pigment was present over the whole surface except the head and the anterior part of the base of the dorsal fin which were white. The fish was kept alive in captivity for two months and was observed to lie always with its eyes uppermost so that the upper side was white and the lower side coloured —Ideas on the origin of flight Dr Baron I **Nopcsa**. The author stated that from the mechanical point of view a patagium and a set of flight-feathers were different organs He pointed out the osteological analogies between bats and pterosaurs, on the one hand, and between birds and dinosaurs on the other He suggested that bats and pterosaurs had arisen from leaping arboreal forms, whilst birds had come from a terrestrial, cursorial stock —The azygos veins in the Mammalia F E **Beddard**

Royal Microscopical Society February 20 —Lord Avebury, F R S president, in the chair —An early criticism of the Abbe theory J W **Gordon** This was a reply to a paper by Mr Conrady with the same title, read before the society on October 17, 1906. At the conclusion of his paper Mr Gordon exhibited on the screen some photographs of the spectrum produced by the fine ruling of an Abbe diffraction plate —Some Tardigrada from the Sikkim Himalaya James **Murray**.—Some Rhizopods from the Sikkim Himalaya Dr Eugène **Penard**.—An incident in ant life Major **Sampson**. A thick living arch of travelling ants was seen by Major Sampson, now in Southern Nigeria, across a sunny road, and in the centre hundreds of pupæ being carried along in the shade thus caused This is remarkable, because the African ant, as a rule, dislikes the sun

Physical Society, February 22 —Prof J Perry, F R S, president, in the chair —Transformer indicator diagrams Prof T R **Lyle**. The term "transformer indicator diagram" has been applied by Prof Fleming to any series of periodic curves which give the forms, relative phase positions, and magnitudes of the waves of current and E M F on both the primary and secondary sides of a transformer when working Such diagrams have been obtained by many investigators in different ways, but by none of the methods hitherto used has it been possible to determine directly and independently either the wave of magnetic flux F in the core, or the wave of magnetising-current turns usually represented by the vector sum $n_1C_1+n_2C_2$ It is shown in the paper that the integral $\int(n_1C_1+n_2C_2)dF$ for one cycle is equal to the total iron loss per cycle, and the advantage of being able to determine both $n_1C_1+n_2C_2$ and F directly and accurately is apparent By means of the wave tracer designed by the author, not only can the E M F and current waves be accurately determined, but also the wave of magnetic flux pulsating in the core of the transformer, and in addition the magnetising current wave, $n_1C_1+n_2C_2$, can be obtained with the same accuracy as any of the other quantities —Ionisation of gases by α particles of radium Prof **Bragg** The present paper contains an account of further progress in the work of determining the relative amounts of ionisation produced by the α particle of RaC in different gases and vapours The view is discussed that the ionisation (i) is connected with the expenditure of energy (e) of the α particle by the expression $\delta i/\delta e = kf(v)$, where k is a constant for each gas which may be termed the specific ionisation in terms of air as unity, the determination of which for various gases has been attempted in the present paper, and $f(v)$ is a function of the velocity of the α particle only It is established that the total number of ions produced by the α particles of RaC varies with the nature of the gas, and is for most compound gases and vapours examined about one-third greater than for air The conclusion is drawn that the primary action of the α particle is a subatomic one The production of ions may be considered a secondary consequence which varies with the energy expended the speed of the particle, and the nature of the molecule ionised The stopping-power of a gas is more nearly an additive property of the atoms in the molecule than any other property except mass, and this is an effect quite apart from the proportionality of stopping-power to the square root of the atomic weight For atomic weights below 30 the stopping-power, divided by the atomic square roots, is abnormally low an effect curiously similar to the case of atomic heats There does not appear any evidence that the chance of an atom being ionised is dependent upon whether it is already ionised, that is occasionally the molecule may lose several ions

Anthropological Institute, February 26 —Dr A C Haddon, F R S vice-president, in the chair —Note on a dolmen called "La Pierre Turquaise," at Presles, France A L **Lewis**. The monument consists of a chamber, with an entrance, formed by two small stones, which originally supported a third. The roof is formed of nine stones. The axis is between twenty and twenty-five degrees south of west and north of east The total length is about 45 feet The monument appears to have been sepulchral, but rites of some kind were also probably performed at it —The ethnology of modern Egypt Dr C S **Myers**. The measurements, notes, and photographs taken in this investigation led to the conclusions (1) that, compared with the "prehistoric" people of 5000 B C, the modern

inhabitants show no sensible difference in head measurements or in the degree of scatter of individual measurements about their average, (2) that the modern Copts throughout Egypt are less negroid than the modern Moslem population, (3) that both the Copts and the Moslems in Upper Egypt are more negroid than those in Lower Egypt, (4) that from the anthropometric standpoint there is no evidence of plurality of race in modern Egypt.

Geological Society, February 27.—Sir Archibald Geikie, Sec. R.S., president, in the chair.—The Lower Ordovician succession in Scandinavia: W. G. **Fearnsides**. The paper is a stratigraphical account of the Dictyonema shales, the Ceratopyge beds, the Didymograptus shales, and the Orthoceras limestone of Sweden and southern Norway, and is based upon field-observations of Scandinavian type-localities made by the author during the summer of 1906. The beds are discussed under the following headings:—(c) Didymograptus shales and Orthoceras*kalk*, (b) Glauconite shales and Ceratopyge*kalk*, (a) Dictyonema and Bryograptus shales, which are found to be applicable to all the sections visited. This stratigraphical evidence is considered in its bearing upon the question of the definition of the boundary between the Cambrian and the Ordovician systems, and the author follows the Scandinavian authorities in considering that, so long as the Dictyonema horizon is available, the evidence of sudden faunistic change within the series discussed is too slight to warrant a palæontological separation of the systems at any other horizon. A comparison of the British Tremadoc and Arenig series with these Scandinavian rocks concludes the paper, and it is maintained that the time has now arrived for British geologists to come into line with their Continental brethren and to include the Dictyonema and the overlying Tremadoc beds as the lowest series of the Ordovician system.—The occurrence of pseudomorphous pebbles of pyrites at the Crown Reef Mine (Witwatersrand): C. B. **Horwood**. Reference is first made to the existence of calcite "pebbles" in the Main Reef, which Mr. Julius Kuntz believes to be due to the replacement of quartz by calcite. Pellets of iron-bisulphide known as "buckshot" occur at the Rietfontein "A" Mine in the Buckshot Reef: they exhibit radiate fibrous structure, and are probably of concretionary origin. At the Crown Reef Mine a few "pebbles" of pyrites, some measuring as much as an inch in length, occur in a narrow band of conglomerate at the contact of the reef with a basic dyke.

DUBLIN

Royal Dublin Society, February 19.—Prof. A. W. Conway in the chair.—Electrical seed-testing: Prof. T. **Johnson**. A demonstration was given of the method of using the apparatus devised by Dr. A. D. Waller, F.R.S., for testing for a "blaze" current in electrical seed-testing.—Series in spectra: Prof. A. W. **Conway**. A sphere of positive electricity is supposed, capable of executing radial elastic vibrations of low frequency. In any mode a negative electron could at certain periods be at rest for some time at any one of the nodal surfaces. The frequencies of the oscillations of an electron at the various nodes would be connected by an equation

$$a+bn^{-2}+Cn^{-4}$$

where n is a natural number.

PARIS

Academy of Sciences, March 4.—M. Henri Becquerel in the chair.—The heats of combustion and formation of some nitrogenous principles playing a physiological *rôle*: M. **Berthelot** and Ph. **Landrieu**. Thermochemical data for hæmatin, bilirubin, and hæmoglobin *from the horse*.—The phosphorescence of uranium salts in liquid air: Henri **Becquerel**. At the temperature of liquid air the bands observed in the spectrum at ordinary temperatures are partly resolved into lines, and the bands not resolved into lines contract and are more sharply defined. The phosphorescent spectrum is similarly modified.—The alcoholysis of castor oil: A. **Haller**. Castor oil was treated with various alcohols containing 1 per cent. of hydrochloric acid, and the esters obtained submitted to repeated fractional distillation in a vacuum. Methyl, ethyl, *n*-propyl, and isobutyl ricinoleates were obtained, the physical constants of which are given. The presence in the oil of the glycerides of stearic, ricinoleic, and dioxystearic acids was confirmed.—The purification of sewage: A. **Muntz** and E. **Lainé**. In previous work the authors have found that for intensive nitrification peat forms the best medium for the work. This result has now been applied to the purification of sewage. The filter bed consists of spongy peat, to which chalk has been added in sufficient quantity to neutralise the acidity, together with a little garden mould to supply the necessary nitrifying organisms. After passing through two small septic tanks, the sewage is filtered through the peat-bed at the rate of 1 to 1.25 cubic metres per day per square metre of surface, and analytical data are appended showing the completeness of the purification.—The obliteration of the pleural cavity in the elephant: Alfred **Giard**. A continuation of the discussion raised by Mme. Phisalix.—Remarks on the preceding paper by M. Edmond **Perrier**.—The formula of addition of spherical functions: Niels **Nielsen**.—The constitution of the atom: H. **Pellat**. Starting with the present theory of the constitution of the atom as being formed of a centre positively charged around which gravitate negatively charged electrons, the calculation is made that for sodium, zinc, iron, and copper, the only light radiations possibly emitted by the vapours should be well in the ultra-violet. As this is not in accordance with the known facts, it is pointed out that some of the fundamental assumptions of the theory must be modified.—The refraction of bodies: Jules **Amar**.—Some new modes of formation and preparation of titanium tetrachloride: Em. **Vigouroux** and G. **Arrivaut**. Commercial ferrotitanium, from which the greater part of the iron has been removed by treatment with dilute hydrochloric acid, is dried and heated in a current of chlorine. A good yield of titanium tetrachloride is thus obtained, and details are given of the method of purifying it, especially from the accompanying ferric chloride.—The synthesis of tertiary amidines: phenyl-amido-ethane-oxymethane-phenylimino phenylamine: Emm. **Pozzi-Escot**.—The constitution of hordenine: E. **Léger**.—A method of synthesis of non-substituted β-ketonic nitriles: Ch. **Moureu** and I. **Lazennec**.—A new method of estimating ammonia in waters: Albert **Buisson**. The method is based on the product of an insoluble compound by the addition of mercuric chloride and sodium carbonate.—The origin of the formation of aldehydes in cheese: MM. **Trillat** and **Sauton**. The bite in cheese has been shown to be largely due to the formation of aldehydes. In the present paper the best means of preventing aldehyde formation is studied.—The toxic power of the definite principles in *Tephrosia Vogelii*: M. **Hanriot**.—The colloidal properties of starch: J. **Fouard**.—The relations existing between the oxyhæmoglobin and the gases of the blood: MM. **Piettre** and **Vila**.—The influence of the physical nature of the walls on the increase of activity of the pancreatic secretion by calcium salts: C. **Delezenne**.—The structure of the cubical form of sodium chlorate possessing rotatory power: H. **Copaux**. The cubical crystals of sodium chlorate owe their rotatory power to the macles of a quasi-cubic orthorhombic form slightly doubly refractive.—A contribution to the anatomical study of the Raphia of Madagascar: P. **Claverie**.—The edible fishes of Lake Melah (Algeria): J. **Bounhiol**.—A new form of anidian evolution: Jan **Tur**.—The existence in the Sipunculidæ of Schizogregarians belonging to the family of the Selenidiidæ: L. **Brasil** and H. B. **Fantham**.—Reclamation of priority on the subject of a note by M. Maurice Dupont: Charles **Henry**.—The physiology of the hypophysis of the brain: C. **Paulesco**.—The intestinal absorption, the formation, and the utilisation of reserves in rotifers: P. **de Beauchamp**.—The function of the intestine in fibrinogenesis: M. **Doyon**, Cl. **Gautier**, and A. **Morel**.—The lava and minerals of the volcanoes of the Puys chain, the age and cause of the eruptions: Ph. **Glangeaud**.—The graphitic schists and quartzites of Berric, and on their relations with those of Morbihan, of Sarzeau-Guérande, and Belle Ile: M. **Pussenot**.—The cañons of Provence and the irregularities in the curves of equilibrium of underground water: E. A. **Martel**.—The diminution in the intensity of the earth's magnetic field as a function of the altitude in the *massif* of Mont Blanc: A. **Senouque**.

NEW SOUTH WALES

Royal Society December 5 1906 —Prof T P Anderson Stuart president in the chair —Bibliography of Australian, New Zealand and South Sea Island lichens (second paper) E **Cheel** (1) Analysis of a specimen of sea water from Coogee (2) analysis of the ash of a New South Wales seaweed (Ecklonia) (3) analysis of Roman glass from Silchester with special reference to the amount of manganese and iron present C J **White**.—Analyses of slate shale and of tufaceous sandstone from the Narrabeen series S G **Walton** In these analyses special attention was paid to the determination of smaller pieces of the rarer elements —Gold nuggets from New Guinea showing a concentric structure Prof **Liversidge** These nuggets presented the usual external appearance but when sliced polished and etched with aqua regia they showed in parts a concentric structure but no macro crystalline structure Out of a very large number of gold nuggets examined for several years past these two are the only ones which have shown a lamellar structure Apparently the layers of gold were deposited within a cavity in the same way as agates are built up by the deposition of layers of quartz and chalcedony The evidence is against the successive layers having been deposited around a central nucleus The gold in one was 88 95 per cent and silver 1 per cent and the other 88 25 per cent and silver 1 05 per cent —The rate of decay of the excited radio activity from the atmosphere in Sydney S G **Lusby** and T **Ewing** The rate of decay of the excited radio-activity in Sydney is found to be practically the same as that obtained by Rutherford and Allan for Montreal (*Phil Mag* 1902) and by Bumstead in New Haven (*Am Journ* Sci 1904)

DIARY OF SOCIETIES

THURSDAY MARCH 14

ROYAL SOCIETY at 4 30 —On the Gravitational Stability of the Earth Prof A E H Love F R S —The Total Ionisation of Various Gases by the α Rays of Uranium T H Laby —On the Ionisation of Various Gases by the α β and γ Rays R D Kleeman —Capillary Electrometer Records of the Electrical Changes during the Natural Beat of the Frog's Heart Prof F Gotch F R S

ROYAL INSTITUTION at 3 —Biology and Progress Dr C W Saleeby

SOCIETY OF ARTS at 4 30 —The City of Madras Sir James Thomson

MATHEMATICAL SOCIETY at 5 30 —Exhibition of a New Calculating Machine C W Evans Cross —On the Reduction of the Factorisation of Binary Septans and Octans to the Solution of Indeterminate Equations of the Second Degree Dr T Stuart —Invariants of the General Quadratic Form *Modulo 2* Prof L E Dickson —On Partial Differential Equations of the First Order J Brill

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —*Adjourned discussion on* the Transmission of Electrical Energy by Direct Current on the Series System J S Highfield

FRIDAY MARCH 15

ROYAL INSTITUTION at 9 —Problems of Applied Chemistry Prof C Lunge

INSTITUTION OF MECHANICAL ENGINEERS at 8 —Petrol Motor Omnibuses W Worby Beaumont

SATURDAY MARCH 16

ROYAL INSTITUTION at 3 —Röntgen Kathode and Positive Rays Prof J J Thomson F R S

MONDAY MARCH 18

VICTORIA INSTITUTE at 4 30 —Survivals of Primitive Religion amongst the People of Asia Minor Rev G E White

TUESDAY MARCH 19

ROYAL INSTITUTION at 3 —The Visual Apparatus of Man and Animals Prof William Stirling

INSTITUTION OF CIVIL ENGINEERS at 8 —The Victoria Falls Bridge G A Hobson

ROYAL STATISTICAL SOCIETY at 5

SOCIETY OF ARTS at 8 —Oils Varnishes and Mediums used in the Painting of Pictures A P Laurie

ZOOLOGICAL SOCIETY at 8 30

MINERALOGICAL SOCIETY at 8 —On the Minerals of the Silvermines District, co Tipperary A Russell —On Baddeleyite from Ceylon G S Blake and Dr G F Herbert Smith —On the Silver Deposit in the Perran Mine Perranzabuloe Cornwall F H Butler —Zinciferous Tennantite from the Binnenthal Dr C I Prior and R H Solly

FARADAY SOCIETY at 8 —The Potential of Hydrogen liberated from Metallic Surfaces H Nutton and H D Law —Electrode Potentials in Liquid Ammonia F M G Johnson and N T M Wilsmore —The Impedance of Solutes in Solvents as manifested by Osmotic Pressure J G A Rhodin —The Electrolytic Deposition of Zinc using Rotating Electrodes Dr H Slater Price

WEDNESDAY MARCH 20

SOCIETY OF ARTS at 8 —Smoke Prevention in Factories and Electric Supply Stations J B C Kershaw

ENTOMOLOGICAL SOCIETY at 8 —The Vinegar Fly (*Drosophila funebris*) E E Unwin —The Structure and Life history of the Holly Fly Prof L C Miall F R S, and T H Taylor

ROYAL METEOROLOGICAL SOCIETY at 7 30 —The Exploration of the Air Major B F S Baden Powell

ROYAL MICROSCOPICAL SOCIETY at 8 —Some South African Tardigrada James Murray —*Exhibition* Specimens of British Mycetozoa A E Hilton

THURSDAY, MARCH 21

ROYAL INSTITUTION at 3 —Biology and Progress Dr C W Saleeby

CHEMICAL SOCIETY at 8 30 —The Synthesis of Polypeptides Emil Fischer —Organic Derivatives of Silicon Part iii. *dl* Benzylmethylethylpropylsilicane and Experiments on the Resolution of its Sulphonic Derivative F S Kipping —On the Reduction of Carbon Dioxide to form Aldehyde in Aqueous Solutions H J H Fenton —The Mechanism of the Rusting of Iron: G T Moody —Some Compounds of Guanidine with Sugars Part I R. S Morrell and A E Bellars

LINNEAN SOCIETY at 8 —On the Origin of Angiosperms E A Newell Arber and John Parkin —*Exhibitions*: Water-colour Sketches of Alpine Flowers Miss Helen Ward —Photographs of Transvaal Trees and Tree Scenery J Burtt Davy

INSTITUTION OF ELECTRICAL ENGINEERS at 8 —Rail Corrugation J A Panton

FRIDAY, MARCH 22

ROYAL INSTITUTION at 9 —Rays of Positive Electricity: Prof J J Thomson F R S

PHYSICAL SOCIETY at 5 —Experimental Mathematics Mr Pochin.—Logarithmic Lazytongs and Lattice Works Mr Blakesley —A Micromanometer Mr Roberts —Electrical Conduction produced by heating Salts Mr Garrett

INSTITUTION OF CIVIL ENGINEERS at 8 —A Point in Turbo-Alternator Design F J Kean

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ROYAL INSTITUTION at 3 —Röntgen Kathode and Positive Rays Prof J J Thomson F R S.

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THURSDAY, MARCH 21, 1907

SEX AND CHARACTER

Sex and Character. By Otto Weininger. Authorised translation from the sixth German edition. Pp. xxii+356. (London: W. Heinemann, 1906.) Price 17*s.* net.

WEININGER'S interest in his problem is much more philosophical than scientific, but he finds the basis of his theory in a biological idea, and thus challenges scientific criticism. His philosophy is of the non-empirical type, and he is strongly influenced by Plato and the transcendentalism of Kant. His psychology and ethics are thus static and non-evolutionary, and he is the less likely to find any strong support from modern thinkers, for whatever in these days may be our views as to the method by which it has come about, the *fact* of organic evolution is beyond dispute, and the application of evolutionary ideas to psychology and ethics hardly less compelling.

The book is an attempt to reduce the relation of the sexes to a single principle, and Weininger brings arguments from biology, psychology, logic, and ethics to enforce his claim to have established it. He begins by predicating a permanent bisexual condition in human beings, pointing out that the sexual condition in the embryo is derived from an earlier indeterminate stage, and that there are always traces of bisexuality in the adult, *e.g.* the down on a woman's face in the position of the beard and the presence of glandular tissue connected with the nipples in man.

"The fact is that males and females are like two substances combined in different proportions, but with either element never wholly missing. We find, so to speak, neither a man nor a woman, but only the male condition and the female condition. Any individual 'A' or 'B' is never to be designated merely as a man or as a woman, but by a formula showing that it is a composite of male and female character combined in different proportions, for instance as follows:—

$$A \begin{cases} aM \\ a'W \end{cases} \quad B = \begin{cases} bW \\ b'M \end{cases}$$

always remembering that each of the factors *a*, *a'*, *b*, *b'* must be greater than 0 and less than unity."

Weininger elaborates this biological idea and carries it into the field of psychology and ethics. He seeks to explain the periodic movements for the emancipation of women by the periodic appearance of unusual numbers of women approaching the male standard (his so-called hermaphrodites), and supposes that all such movements die out because the hermaphrodite individuals who create the demand for emancipation after a certain time are no longer produced, an argument which he supports by biological analogies, but though there have been such movements in the past, they were doomed to failure, because it is only in our own epoch that the fear of rape, which is the *real* reason for the suppression and prohibitions accorded to women, has become so small a probability that it may be disregarded in view of the enormous gain to intellect and character afforded by the fullest possible freedom.

Weininger proceeds to inquire what are the essentials of the ideal maleness and the ideal femaleness which form the ends of his series, and on his way elaborates his theories of psychology and ethics. Memory he takes as the basis of logic and of ethics, for without memory there can be no perception of identity, and hence no possibility of a syllogism. The perception of identity necessitates the supposition of a transcendental ego which is out of time, for the ego must be permanent and the same at all times to be able to recognise identity when it turns up. James, however, has shown that for the purposes of psychology all that is necessary is the present thought which contains and remembers and recognises all past thoughts. The thought, then, *is* the thinker, and the transcendental ego a needless and cumbersome abstraction.

How does this male psychology apply to woman? Thus dogmatically Weininger:—Woman has no memory, and hence no perception of identity, hence she is illogical and non-moral. She is incapable of forming concepts, all her ideas are in the vague stage in which the object perceived is inseparable from the character or feeling with which it is perceived. That is to say, in general, her mentality is in a less differentiated or articulated stage than man's. Here again we might find some grounds for seeing a partial truth in our author's contentions, if he were content to say that, on the whole, this was true of the average woman as compared with the average man, all due allowance being made for education and logical training; but he goes very much farther than this. "Woman has no ego," and moreover, "I must again assert that the woman of the highest standard is immeasurably below the man of lowest standard." Here common-sense observation and all anthropological, psychological, and ethical investigations give him an emphatic negative.

Woman, then, according to Weininger, is nothing (*Nichts*), the complete antithesis of man, who is something, an ego, a microcosm (*All*), though containing within him the possibility of nothingness (*Nichts*), of chaos, of insanity, of crime. What, then, is her place in humanity? "Woman is sexuality, man is sexuality and something more." Here, then, we have the secret of woman. She is nothing but the instrument of a blind instinct to perpetuate the race, all her practical interests are in sexual congress (the courtesan type), in procreation (the mother type), in match-making. "The idea of pairing is the only conception which has positive worth for women." "The female is concerned altogether with one class of recollections, those connected with the sexual impulse and reproduction."

The women of history and of daily experience clearly cannot be fitted into Weininger's conception of them, but that, he would say, is because of their extraordinary capacity for assimilating man's ideas, his morality, his ideals of chastity, of honour, and his respect for logic. When a woman accepts man's standards too thoroughly her nature (sexuality) re-

Y

volts, and hysterical crises result The patient alternately passionately repudiates her sexual instincts and brazenly asserts them It is hard to imagine how a creature without memory or logic could perform all the mental processes involved in this assimilation and repudiation

Weininger now turns on man Woman is nothing, and therefore non-moral, not immoral, but man in his relations with her is always immoral For he always regards her as a means to an end, and not as an end in itself, in sexual congress as the instrument of pleasure and physical reproduction, in love as the instrument of self projection and mental reproduction, but woman is part of humanity, and must be regarded as an end in herself The present writer, for one, fails to comprehend how a person who has no ego and is nothing can be regarded as an end in herself!

Specious and persuasive as our author shows that he can be it is clear that he is very far from establishing his principle The book is a remarkable one for the author's years—he was only twenty-one when he wrote it remarkable in the learning and thought which he brings to bear no less than in the largeness of its conception and the breadth with which the matter is treated It is brilliantly written and contains at once profound reflections and almost laughably unfounded statements of fact It is at times stimulating and suggestive, but nevertheless often irritating, because the central idea seems rather an obsession of a brilliant but inexperienced mind than a conception to which the writer has been driven by carefully considered facts

Weininger died by his own hand in 1903, and we are told by the friend who collected his posthumous papers that he felt within him criminal tendencies, and could no longer continue the struggle between these tendencies (*Nichts*) and his intelligible ego (*All*)

I A

SOME RECENT LOGARITHMIC TABLES

Tableaux logarithmiques, A et B By Dr A Guillemin Pp 48 of explanation, with two tables 35×55 and 46×35 cm (Paris Félix Alcan, 1906) Price 4 francs complete

Clive's Mathematical Tables Pp 40 (London University Tutorial Press Ltd, 1906) Price 1s 6d

Five-figure Mathematical Tables for School and Laboratory Purposes By Dr A Du Pré Denning Pp 21 (London Longmans, Green and Co, 1906) Price 2s net

DR GUILLEMIN'S two tables possess several interesting features Taking, in the first place Table A, which is used for working to six places of decimals, this contains the *antilogarithms*, calculated to six decimal places, of all decimals of three places from 0 000 to 0 999 In a third column are given the values of log a corresponding to values of log $(1+a)$, from 0 000000 to 0 000999 When it is required to calculate logarithms to six places of decimals, the principle employed is as follows —Let N be the number the logarithm of which is required, m the nearest number in the column of antilogarithms, so that $\log m = \log N$ to three places of decimals Then if $N = m(1+a)$ we have

$$\log N = \log m + \log (1+a)$$

By subtraction we find $N-m$, which is equal to ma From the tables we can find by inspection $\log ma$ to three decimal places, and subtracting $\log m$, which is known, we have $\log a$ to three decimal places The table then gives $\log (1+a)$ to three significant figures, and these figures are the second three decimals to be written after $\log m$ in order to give $\log N$ to six places

In the second table (Table B) the values of the antilogarithms are given to nine places of decimals, and the values of $\log a$ to six places In each table the number of entries is one thousand, the logarithms going from 0 000 to 0 999 With Table B, which measures 35 cm by 46 cm, it is possible to calculate any logarithm to nine decimal places, but the work involves something more than a repetition of the process used for Table A If, for example, it is required to find log 7, there is no difficulty in obtaining the first six figures 0 845098 but the remainder to be operated on in order to find the next three figures cannot be got until we have worked the whole thing backwards and calculated the antilogarithm of 0 845098 to nine decimal places

It is not often that logarithmic calculations have to be taken to nine decimal places, but if this has to be done the present method, which is very fully explained by the author avoids the use of cumbersome books of tables and it will probably be found, with a little practice not to take much longer—perhaps not even to take so long as the interpolation methods which such books of tables would necessarily involve

The other tables under review are good examples of a number of small tables which have been issued during the last few years with the object of saving elementary students in mathematics, as well as students in physics and chemistry, from the tedious work of looking out seven-figure logarithms in the large "Chambers" It has been felt for a long time past that working with four figures is sufficient for teaching purposes, on the other hand, the student of experimental science often requires the additional accuracy obtained by an extra decimal place But though several cheap books of four-figure tables have been issued during the past few years, we had to retain "Chambers" for teaching and examining junior students until about four months ago, as none of the other books we saw contained what was necessary One contained natural sines and cosines, but not their logarithms, another contained natural and logarithmic sines, but no cosines

Junior students are very fond of using natural sines when they ought to learn to use their logarithms They invariably get inaccurate results by clumsy methods, and it would not be a bad plan to remove the tables of natural sines from the books supplied for examinations

The proper arrangement for a table of trigono-

metric logarithms is one which shows clearly the dual use of the tables for reading off the logarithmic sines of angles and the logarithmic cosines of their complements With small books of tables this is best done by using the right-hand column and top line for logarithmic sines, the left-hand column and bottom line for logarithmic cosines This is the arrangement adopted by Dr Briggs in his "Clive's Mathematical Tables" The same arrangement is followed in regard to tangents and co-tangents The tables of secants and cosecants are another desirable feature By adding the logarithm of a cosecant instead of subtracting the logarithm of a sine many compound expressions may be calculated by a single addition sum It is a pity that logarithms of reciprocals are not also given The tables are given to five places, and corrections are given in all of them where the differences are irregular The explanatory matter is very useful to students, notably the definition of significant figures

Dr Denning, in his introduction remarks that "Criticisms and suggestions for future editions will be welcomed" The first criticism which suggests itself is that a book where logarithms of numbers less than four *have necessarily* to be taken from a table of antilogarithms, and logarithms of numbers greater than four from a table of logarithms, is far too ingenious to put into the hands of a beginner The object of this arrangement is, of course, to avoid the large and irregular differences that occur with logarithms of the lower numbers and antilogarithms of the higher ones If the book is *not* meant for beginners the arrangement is good, but for teaching the use of tables the complete tables of logs and antilogs should be given and students should be taught later on when to use each The insertion of corresponding tables for obtaining logarithms of reciprocals is a good feature It seems rather curious that no one has adopted the plan of bordering a table of antilogarithms with a bottom line and right-hand column containing the arithmetical complements of the numbers in the top line and left-hand column Such an antilogarithm table would give logarithms of reciprocals very simply

The arrangement of the trigonometrical tables is not very clear There are no head- or footlines to the middle page, and while the columns look to run on from one page to the next, they do not really do so The left-hand column of the first two pages goes from 0° to 15°, and we naturally expect to find 15° to 30° on the next page, but instead of that we find 30° to 45°, the entries for 15° to 30° being on the right-hand column of the first two pages The misprint "co-functions" at the foot of p 16 does not really introduce additional confusion The book contains tables of squares and cubes for those who like to indulge in such luxuries Pages of physical and chemical constants, electric units and data, together with some of the differentiation and integration formulæ also given, are really useful, and, finally, some "simpler mechanical relationships" and statements of the binomial and Maclaurin's theorems would be of greater value to the average student if they bore the heading "Things that Ought Not to be Learnt"

These criticisms do not preclude us from stating that the tables will be very useful to such science students as have learnt to find their way about in them

GEOGRAPHY AS A LIVING SCIENCE

Beobachtung als Grundlage der Geographie By Prof Albrecht Penck Pp 63 (Berlin Gebruder Borntraeger, 1906) Price 1 60 marks

THIS little work, which is choicely printed is a record of a delightful personality It contains the parting address of Prof Penck to the students of Vienna, and his introduction to those of Berlin, now the suzerain-city of the land where he was born The first words "Liebe Freunde" ring very truly in our ears, and the title of the pamphlet recalls to those friends scenes in very many lands Especially prized by the present writer is a little photograph—a mere imperfect sketch, if you will—in which Prof Penck is seen writing up his notes in the open air, on the very edge of one of the world's great landscapes, where the scarp of the African tableland goes suddenly down towards the sea Like his distinguished botanical colleague, Prof Engler, Penck has realised the tradition of Humboldt, and has felt that the German people "darf sich in geographischer Arbeit nicht auf sein Gebiet beschranken es muss solche auf der ganzen Erde leisten" (p 60)

The striking contrast of geographical position makes it necessary to urge the claims of travel more strongly in Berlin than in Vienna The romance of Vindobona and Carnuntum, of the Germanised city facing the great "Kessel, in den sich Volkerwoge auf Volkerwoge sturzte" calls us eastward in the first few pages, and we ask ourselves What has Berlin to offer after this? In the last pages, however, we meet our answer—Germany centres in the flat land of Berlin, but Germany has spread her wings Near the North Pole lies King William Land, near the South Pole lies Emperor William II Land, and the union of the German States has allowed all Germany to look towards the sea On this medium, which no longer divides but joins the continents, we trust that ships may bear in all directions the students of Berlin, imbued as they cannot fail to be with the high and genial spirit of their master

In the Austrian section of the pamphlet, Prof Penck shows how tectonic geography has specially developed in Vienna He urges, however, that the relations between internal structure and surface-features are not always so close as has been supposed The forms associated with the higher regions of the Alps are thus due less to the recent folding of the chain than to the surface-action of the glaciers of the Ice age and of modern times (p 16) which continuously carry away, by a nibbling action, fragments from the valley-walls The author believes that the Alps were far more rounded before the advent of the Ice age, though they possessed (p 20) a much

dissected Flysch zone, and that the contrast between the surface of the young folded chain and that of the old "Rumpf" of Bohemia is in reality a development of fairly recent times The Alps, moreover (p 18), appear to have gained in height, by a vertical movement, since the formation of the interglacial lakes, and thus their present preeminence is not to be ascribed to lateral thrust alone

The uniformity of level of peaks in the same district is then discussed, and it is argued that the cutting of valleys in a mass undergoing denudation influences the heights of the peaks along the valley-walls After a long time, where the hardnesses of the rocks concerned do not greatly vary, the upstanding points at any given distance from the centre of the chain will tend to be reduced to much the same level above the sea, and the impression given will be that they were originally points on a continuous dome It is clear that the author here asks us to be cautious in applying the fascinating doctrine of the "peneplain" and of subsequent elevation to every dissected highland

The consideration of the post-Pliocene uplift leads us on to the vigorous and partly post-Roman depression of the Adriatic region, with the compensating elevation of the Apennines, then follows a survey of river-courses in central Europe The movement of masses of land in vertical blocks, to which geomorphological studies in the Alps have directed attention (p 36), is shown not to be inconsistent with horizontal movements, and with folding, where one block rides over another (p 34) The relative importance of vertical movement and horizontal thrusting, and how far the one may be a manifestation of the other are left as problems for the future

So far, the results of recent observation, geographical it may be, but with a remarkably geological trend, have been summarised for the region of which Vienna is the natural centre A few words in praise of observational research conclude this section The title of the pamphlet is, however, really justified in the discourse to the students of Berlin which opens with a somewhat depressing picture of their natural environment Men, not mountains have made the greatness of the geographical school of northern Germany Prof Penck contrasts the influence of Karl Ritter, who regarded the earth from the point of view of its suitability for man with the later and more scientific attitude of von Richthofen In each case the geographical outlook depended on the stage reached contemporaneously in the development of scientific thought Ritter expressed (p 47) the teleological views of his time, Richthofen "nimmt die Erdoberfläche nicht als gegeben, sondern als geworden, naturgemass daher bei ihm die enge Fühlung zwischen Geographie und Geologie" Followers of Richthofen should insist on being observers, not mere critics and coordinators Modern means of communication have made travel a matter of money only, instead of both time and money, as in bygone years The small scale of the maps of the more recently explored countries masks the immense amount of work that is waiting to be done, and the district adjacent to a colonial railway station may well reward the student who goes out skilled in observation With such stimulating words Prof Penck enters on his new province in Berlin, and he may be sure that his friends in the four corners of the world will welcome those whom he has trained

GRENVILLE A J COLE

THE STRENGTH OF MATERIALS

Text-book on the Strength of Materials By S E Slocum and F L Hancock Pp xii+314 (Boston and London Ginn and Co, n d) Price *12s 6d*

THIS book is intended to provide for the needs of engineering students both in the class-room and in the laboratory, hence it is divided into two parts, the first part treating of the theoretical side of the subject and the second dealing with the experimental side The first two chapters are devoted to a general discussion of the relations between stress and strain as an introduction to the development of the more special rules applicable to the structural forms in common use by engineers and architects There is an unfortunate slip on p 10 in the paragraph dealing with the fatigue of metals, in quoting some of the results obtained by Bauschinger in his experiments, the material is stated to have been "cast iron"—it was, of course, "wrought iron" Chapters iii and iv deal with stresses and strains in beams, and there are two useful constructions not usually found in text books on this subject, namely a graphical method of finding the centre of gravity and the moment of inertia for a rail, or other similar section, and a graphical solution of the problem of finding the moment of inertia of a reinforced concrete beam of rectangular cross-section

In dealing with the flexure of beams in chapter iv, the problem of continuous beams is fully discussed, and, in addition to the method of three moments, other methods of solution of the problem based on Maxwell's theorem and on Castigliano's theorem, are explained

In the next two chapters the design of struts and shafts is dealt with, also the theorem of helical springs but there is nothing novel in the treatment of any of the problems which have to be solved

In the chapter which treats of the strength of spheres and cylinders under uniform pressure, a neat formula is obtained for the critical pressure just preceding collapse in the case of a hollow circular cylinder subjected to external pressure, and Lamé's formula for thick cylinders is deduced

Two subjects—flat plates and hooks—which in most of the text-books are usually treated in a somewhat unsatisfactory fashion are thoroughly investigated in chapters viii and ix, in the case of crane hooks it is pointed out that the ordinary assumption that the distribution of stress is the same as in a straight beam subjected to an equal bending moment and axial load is not even approximately correct From an analysis of the stresses in a curved piece subject to pure bending strain, a general formula for

the case of a crane hook is deduced, and the method of Résal is explained by which the application of the formula is much simplified The last two chapters of this section are devoted to arches and arched ribs, and to foundation and retaining walls, this is a part of the subject of the strength of materials which generally proves a great stumbling-block to the engineering student, and the authors are to be congratulated on the lucid and thorough fashion in which they have set forth the various solutions which have been found most satisfactory for problems which have been well-known subjects of controversy among engineers and mathematicians for a century or more

The six chapters of part ii are devoted to the physical properties of materials and the most modern methods of determining accurately the various physical constants required in the formulæ of part i Typical testing machines are illustrated and explained, and the various types of apparatus in general use for measuring the stresses in the material undergoing test are described The materials dealt with include iron and steel, reinforced concrete and the other building materials employed by engineers and architects, a number of useful tables are given, and also the standard specifications proposed by the American Society for Testing Materials

The authors have succeeded in producing a new English text-book in which the important subject of the strength of materials, the foundation upon which the whole structure of engineering science is based is treated in a far more complete and thorough fashion than has been the case in the majority of the text-books hitherto available to the engineering student and certain sections of it should prove of great service to those who are actively engaged in engineering design

SCIENCE IN POETRY

Nature Knowledge in Modern Poetry By Alexander Mackie Pp vii + 132 (London Longmans, Green and Co 1906) Price 2s 6d net

IN this book the author deals in a very interesting manner with the many references to the aspects of nature in the poetical works of Tennyson, Wordsworth, Matthew Arnold, and Lowell

We find these poets taking delight in alluding to animated nature in many different ways Not only do flowers, trees, and foliage of all kinds occupy a prominent place in their poems, but animal life figures almost as importantly, birds more especially

Tennyson's references to horses and dogs show an intimate knowledge of these animals, though they do not convey the spirit of one in the habit of taking part in sport, and the author points out that Tennyson was not a sportsman Matthew Arnold's love of dogs is also very obvious, and his poems show how much sympathy he had with them, and what a close observer he was of their ways and habits This comes out more especially in the poems dedicated to his household pets

Interest in the insect world is shown to a greater extent by Tennyson, for he alludes to it frequently, and always with the accuracy which reveals great knowledge Lowell refers more especially to the bee

Love of bird life is common to all these poets, but it is worthy of note, and also pointed out by the author, that the great characteristic of Tennyson's work is that he describes the bird's *notes* to a great extent, and has the happy knack of so doing that the bird he is referring to is unmistakable

We gather in many ways that Tennyson was the more truly scientific man of the poets referred to The character of his allusions and the accurate detail into which he goes are, moreover, beyond the knowledge of the casual observer Wordsworth was more an esctatic admirer, as the author tells us, "his outlook was broader and in one sense less intimate" than Tennyson's He was accurate in his descriptions, but seemed almost fearful lest an intimate knowledge should do away with the beauty and poetry of nature He says,

> "Sweet is the lore which Nature brings,
> Our meddling intellect
> Misshapes the beauteous forms of things,
> We murder to dissect"

And again,

> "Enough of Science and of Art,
> Close up those barren leaves,
> Come forth and bring with you a heart
> That watches and receives"

In the preface to "This lawn a carpet all alive," Wordsworth appears a little more in sympathy with science, but in spite of this he still conveys the feeling that he is of opinion that nature will reveal her mysteries unsought

Tennyson's love of geology is apparent in the frequent references to it and the similes he gives, which clearly show he must have read a good deal on this as indeed on many other less popular subjects for instance he does not shun allusions to the nebular hypothesis spectrum analysis, and astronomy It seems evident that he accepted the theory of evolution for many quotations might be made to show it, but the author contents himself with the following, from "Locksley Hall Sixty Years After"—

> "Evolution ever climbing after some ideal good,
> And Reversion ever dragging Evolution in the mud
> * * * * * *
> Many an aeon moulded earth before her highest, man, was born,
> Many an aeon too may pass when earth is manless and forlorn"

We see, therefore that these poets deal largely with things of scientific interest, and all lovers of nature will find the book of great and permanent value

OUR BOOK SHELF

Geometrische Kristallographie By Ernst Sommerfeldt Pp x + 139, illustrated (Leipzig W Engelmann, 1906) Price 7s net

THE closing decade of the last century witnessed much progress made in the development of the geometrical theory of crystal structure, and we may now have confidence in the certainty of our knowledge regarding the possible types of crystalline

symmetry This advance has not been without marked influence on the methods of determining the physical properties of crystals The old idea to consider a crystal is a solid bounded by plane faces, the relative positions of which harmonised with Hauy's law of rational intercepts, is giving way to the more logical principle that a crystal consists of a homogeneous arrangement of discrete particles in space Indeed, as has been frequently pointed out, a theory which ignores the internal structure cannot avoid the difficulty presented by a peculiar case of pseudo-trigonal symmetry To the new school, which is typified most completely by Schonflies's well-known treatise, the present work belongs

Dr Sommerfeldt devotes a considerable portion of his book to the determination of the thirty-two classes of crystal symmetry He establishes the four possible types of axes of symmetry in the usual way, and proceeds to evolve the classes in the following order —the holohedral groups, the merohedral groups, comprising those possessing centres of inversion those without such centres, but having mirror-image symmetry, and, lastly, those without such centres, and enantiomorphous In the discussion a modification of the "Fundamentalbereich" of Schonflies is introduced It is the smallest spherical triangle defined by the elements of symmetry The symmetry pertaining to each class and the shape of typical simple forms are clearly illustrated by means of the admirable plates, of which there is one for each class except that devoid of symmetry After a brief discussion of the zonal law and the linear and stereographic projections, the author proceeds to what he considers not the least interesting portion of the book, namely, the application of the methods of vector analysis to crystallography This form of mathematical analysis is undoubtedly graced by elegance, and presents the generalised formulæ in neat guise, but its unfamiliarity to the ordinary student of crystallography seriously militates against the general utility of the book The formulæ in question some of which by the way, do not lend themselves readily to arithmetical computation, and are, therefore not of immediate practical use—could be established without greater difficulty by means of ordinary analytical geometry Nevertheless, to the advanced student who may be versed in mathematics it would be interesting and stimulating to study a different method The book concludes with a very complete bibliography and a good index

Untersuchungen über kunstlichen Parthenogenese und das Wesen des Befruchtungsvorgangs By Prof Jacques Loeb German edition, issued with the author's cooperation, by Prof E Schwalbe Pp viii+532 (Leipzig J A Barth, 1906) Price 7 50 marks

THE greater part of this remarkable book appeared in English dress in the Decennial Publications of the University of Chicago, and has been already noticed in our columns As is well known, Prof Loeb set himself some years ago the task of discovering chemical or physical methods of stimulating development in unfertilised eggs Taking every precaution which he could conceive of he has been able to induce artificial parthenogenesis in the ova of sea-urchins, of the annelid Chætopterus and of the gasteropod *Lottia gigantea* He thinks that the list will be added to as our mastery of the technique increases, for he does not believe that there is any essential peculiarity in those ova which develop in response to the artificial stimulation As to the nature of the stimulation Loeb is more and more convinced that it depends on setting-up or increasing oxidation processes in the ovum, and also on the synthesis of nuclein substances from the protoplasmic materials It is possible, he says, that the two processes are interdependent, and that oxidative syntheses take place Everyone will wish more power to this ingenious experimenter's elbow in his untiring efforts to gain control of life

Handbook of Metallurgy By Dr Carl Schnabel Translated by Henry Louis Vol ii Second edition Pp xvi+867, illustrated (London Macmillan and Co, Ltd, 1907) Price 21s net

PROF LOUIS is to be congratulated on the completion of the translation of the second edition of Dr Schnabel's great work Little delay has been experienced in placing it in the hands of English metallurgists, as the corresponding German edition was not published until 1904 The volume which has just been issued contains the metallurgy of zinc, and shorter sections on cadmium, mercury, bismuth, tin, antimony, arsenic, nickel, cobalt, platinum, and aluminium As the first edition appeared nine years ago, there have been great advances in the metallurgy of some of these metals since it was written, and these have caused many alterations and a considerable enlargement in the present volume The changes are distributed throughout, the whole text having been carefully revised, but some of the most striking changes occur in the sections devoted to the production of aluminium on a large scale and to the electrolytic treatment of zinc Electrolytic methods generally are fully treated, the author expressing his indebtedness to the works of Dr Borchers for much of this part of the book

There is little to be said in criticism of Dr Schnabel's book The description of alloys is usually rather meagre, with curiously slight regard to the work of the last twenty years Then, again the rapidity with which the Silesian zinc furnace is giving place to the Belgo-Silesian furnace does not seem to be realised by the author In general however the information is full, accurate and up to date, and is conveyed in a pleasant, readable manner

LETTERS TO THE EDITOR

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The Inoculation Accident at Mulkowal

I SHOULD like to direct the attention of your readers to this matter The evidence regarding the unfortunate Mulkowal accident as given in the *Lancet* and the *British Medical Journal* for February 2 and in the *Journal of Tropical Medicine* for February 1, shows that on October 30 1902 nineteen persons were inoculated from a single bottle of Haffkine's prophylactic labelled 53N while numerous other persons were inoculated from other bottles A week later all the nineteen inoculated from bottle 53N developed tetanus and subsequently died while none of the others suffered at all This gives a strong argument in favour of the view that the poison was associated with the contents of that particular bottle, but the evidence is clearly not mathematically absolute even on this point while it gives no indication whatever as to when the tetanus bacillus entered the bottle It might possibly have entered during the processes of manufacture and bottling or later through a loosened cork or in several ways during the opening of the bottle and the inoculation of the contents But the commission that was appointed to consider the subject seems to have somewhat hurriedly adopted the conclusion that it actually entered during preparation and not later Mr Haffkine as head of the laboratory, was

blamed, especially because he had omitted, for good reasons, to add carbolic acid to the prophylactic. Great alarm was produced. The idea that the poisoning was due, not to local accident, but to carelessness at the laboratory, caused, I have been told, a sudden and wholesale rejection of the invaluable vaccine by the people, with the probable result that thousands of lives may have been lost from plague.

Now it appears that the tetanus bacillus could not have entered the bottle at the laboratory at all! I agree with Prof. Simpson (*British Medical Journal*, February 9) in thinking that the arguments on this point are extremely strong. Had the contents of the bottle been polluted at the outset, they would have had a very offensive smell when used some time later, and would have produced a very rapid infection in the inoculated. As a matter of fact they had no smell, and produced a slow infection, while bottles filled simultaneously were quite sound. Moreover, evidence has been given tending to show that the prophylactic was polluted during the opening of the bottle. On what grounds, then, were the laboratory and its director indicted? Even if the bacillus had entered during the complicated process of manufacture the blame can hardly be attached to the director, who cannot himself superintend the preparation of each bottle. As for the omission of the carbolic acid, the inventor of the prophylactic was himself surely the best judge of how it was to be made.

The serious part of the affair seems to lie, not so much in the loss of life due to the accident itself, considerable as that was, but in the much greater loss which probably followed the suspicion thrown upon the prophylactic by the apparently erroneous judgment of the commission, and more even than this in a certain ingratitude shown in India to a man who is one of the very greatest benefactors it has ever had. Haffkine not only elaborated the method of immunisation by dead culture, but where many a man of science would have contented himself with merely writing an article on the subject, he addressed himself on the contrary, to the much more difficult practical verification. I well remember when he arrived in India with his anti-cholera vaccine and by his energy and perseverance gradually forced his ideas upon the people and the Government. When the frightful calamity of the plague overtook the country in 1896, largely in my opinion owing to the inadequacy of the sanitary organisation and to want of firmness and resolution in the authorities, when measure after measure failed and the people were dying by hundreds of thousands, then Haffkine was the only one who made any successful stand at all against the storm. Quickly inventing his anti-plague prophylactic and forcing the authorities along with him, though he could not control the disaster, he at least checked it by saving thousands, if not hundreds of thousands of human beings who now owe their lives solely to him. The fact that more than six million doses of the prophylactic have been issued in India alone attests the success and magnitude of his work. Yet he has received for it less than nothing. For services which compared with his are really of a trifling nature all kinds of officials receive in many cases pensions, promotion, and decorations. As for him, not only has he received no adequate recognition for his immense service, but he has been blamed for an accident which could not have been due to his fault, and it is doubtful whether he will ever return to a country which has treated him—I can only say—so ungratefully. Contemplating this history, we cannot help being filled with indignation at it. India seems to be becoming quite notorious for its treatment of scientific workers, suggesting ignorance both of science and of the importance of science. I remember the persecution suffered by Colonel King as the result of his work on vaccination, the complete want of gratitude shown to Mr. Hankin for his great work on the prevention of cholera, and several similar cases. While all kinds of people climb easily into the seats of honour, it seems that the men of real merit are fortunate if only they can escape without censure.

I think I shall be excused for writing somewhat strongly on a subject on which I have long felt still more strongly, and on which I have reason to know many others feel as strongly as myself without being as free as I am to express their opinions. It appears to me a foolish thing for a nation to treat great men as we have sometimes treated ours, and the case of Mr. Haffkine—to whom, as he is a foreigner, we are doubly bound to show national gratitude—seems to be a glaring example of such treatment. I hope that steps will be taken to press upon the India Office the need for a reconsideration of the affair; the reputation of the whole country is concerned in it.

March 19. RONALD ROSS.

Mean or Median.

THE article by Mr. Francis Galton in your issue of March 7 entitled "Vox Populi," is exceedingly interesting, and the variations in the estimates of individual competitors afford an admirable instance of the advantage to be derived from the use of the weighbridge at live-stock markets in preference to buyers and sellers relying on their own judgments, but the letter raises several interesting points as to the theoretical treatment of statistical data, to two of which I should like to allude.

In the first place as to bias. No doubt, in estimating carcase weights in such a competition as that referred to by Mr. Galton each competitor judges as truly as he can. But has a butcher (buyer) had his judgment to any extent warped in the course of years through having constantly had to judge of the weight of a beast (when buying) so as to be on the safe side, and secure himself from loss in the event of its not cutting up so well as he anticipated? If so, it might be expected that buyers would have an instinctive tendency to under-estimate the weights of animals, and similarly farmers (sellers) might be expected to over-estimate. This tendency on either side should, of course, not be large, as constant intercourse between buyers and sellers has raised such transactions almost to the point of a fine art. I should therefore like to ask Mr. Galton whether he has any information showing the proportion of these 787 competitors who were farmers and butchers respectively. It is very interesting to observe from the figures given that the estimated weights at each decile are throughout the whole series invariably below the weights which might be anticipated from the normal law of error. This rather looks as if buyers were in a majority in this competition, a not impossible suggestion, since although farmers doubtless attend such exhibitions in larger numbers than butchers, yet the latter would, in a weight-judging competition, probably be more numerous than the former, at least relatively if not actually.

The second, and more important point to which I desire to direct attention is the use of the median in this connection, and I could wish that Mr. Galton had also calculated the arithmetic mean of the 787 observations. I should in fact like to strike a note of hesitation in regard to the too general use of the median in preference to the mean. The former has several advantages, one of which is that it is a form of "average" which can be very readily calculated. It is also very useful in cases such as those referred to in Mr. Galton's letter in NATURE of the preceding week, where it is desirable to eliminate one or two "cranks" whose opinion might have undue weight among a relatively small number of other opinions; in cases, in fact, where the distribution of opinions is known to be very erratic. But is this the case here? I am not sure that Mr. Galton is quite right in regarding the present instance as a case of "vox populi" at all. It is to be remembered that the great bulk of the trade in English cattle—and consequently the determination of the price of our native beef—is the result of transactions such as the competition in question is intended to test. Cattle are practically sold by inspection, and the judgment of buyer and seller as to how much beef there is in a given ox is really much more a matter of skill than of popular judgment; their livelihood depends upon the accuracy of such judgments. In such circumstances is the median a nearer approximation to the truth than the mean? Here the question could be answered by calculating the arithmetic mean. I have not the actual figures, but judging from the data in Mr. Galton's article the mean would seem to be approximately 1196 lb., which is much closer to the ascertained weight (1198 lb.) than the median (1207 lb.).

I should accordingly like to ask Mr. Galton whether he would indicate what, in his opinion, are the chief considerations to be taken into account in giving preference to the mean or the median as the better measure of the "average"? It is a point upon which there is considerable difference of opinion, the recognition of the median is rapidly extending, and some statisticians incline to think that there is a growing tendency to quote it in cases where the ordinary arithmetic mean is preferable.

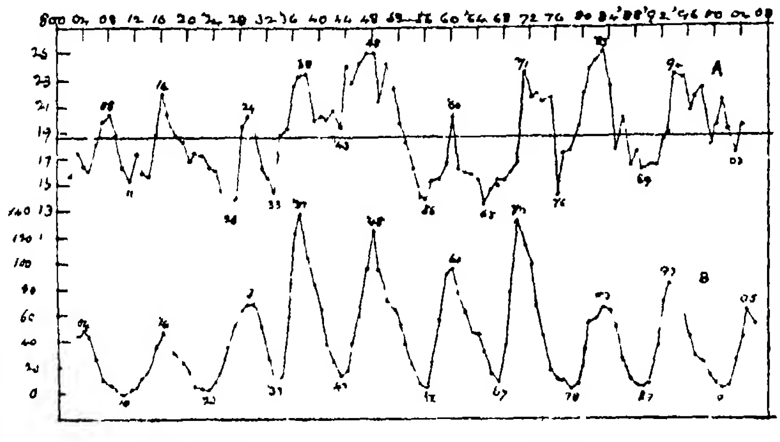
March 16. R. H. HOOKER.

Rothesay Rainfall and the Sun-spot Cycle.

THE rainfall of Scotland has been thought to show in its variations, an influence of the sun-spot cycle of eleven years (in the sense of most rain about maxima). Evidence of this was furnished not long ago by one of our ablest meteorologists, Dr. Buchan, in a paper to the Scottish Meteorological Society (Journal, 3 ser., Nos. xviii.–xix., p. 117).

For such an inquiry the record of Rothesay in Bute is singularly valuable, extending back as it does to the year 1800 in unbroken series.

The relation to the sun-spot cycle may be traced, I think, not only in the total annual rainfall of Rothesay, but also, with more or less distinctness, in the amounts for certain sections of the year, and even individual months.



A, Rainfall July, Rothesay, 1800–1906, smoothed with sums of *five*; B, sun-spot curve.

Thus it is met with in the rainfall of summer, and especially that of July.

I have prepared a curve of the July rainfall (A) in which, by a familiar method, each year-point represents the rainfall of five contiguous Julys (*i.e.* 1800–4, 1801–5, and so on). Below is the sun-spot curve (B). The amount of correspondence between these two seems remarkable, and not easily explained by fortuitous coincidence.

ALEX. B. MACDOWALL.

The Relationship between Diamonds and Garnets.

IN an able paper entitled "The Diamond Pipes and Fissures of South Africa" read before the Geological Society of South Africa rather more than a year ago, Mr. H. S. Harger refers more than once to the significance of the fact that diamonds have been found embedded in garnets. Perhaps the fact that the converse is also true, namely, that the garnet sometimes occurs embedded in the diamond, may not be without its share of interest. I have here at the present time a fragment of a Wesselton diamond, weighing a little more than a carat, containing a small, irregular garnet of about one-tenth of a carat. Originally the fragment seems to have formed a part of a shapeless diamond of perhaps two carats, which evidently enclosed either two or three small garnets, or garnets and diamonds.

J. R. SUTTON.

Kimberley, South Africa, February 20.

THE WEATHER REPORTS OF THE METEOROLOGICAL OFFICE.

THE commencement of the new year was marked by the introduction of a number of changes in the weather reports of the Meteorological Office.

Two notable events have contributed to bring about modifications in the daily report. Arrangements have been made for regular telegraphic reports from Iceland, and for occasional reports by wireless telegraphy from the ships of the Navy.

Thanks to the Danish Government and the Great Northern Telegraph Company, the cable to Faeroe and Iceland, long desired by meteorologists and fishery associations, was laid in the summer of last year. There is a touch of sadness in the reflection that Adam Paulsen, director of the Danish Institute, who led the way so assiduously towards this meteorological Canaan, only got a distant view of the promised land. In August, 1906, he issued a circular on behalf of the Danish Government, defining the terms of subscription for the service of meteorological telegrams from Iceland, but, as already reported in NATURE, he died before the arrangements were completed.

Reports from Thorshavn in Faeroe and from Seydisfjord, on the east coast of Iceland, have been received in London, in a provisional way, since the end of October, but the meteorological telegrams from Reykjavik, on the west coast, commenced on Friday, February 15, as part of the full system which includes messages from Blonduos and Akureyri, where the land line touches the northern fjords, and Grimstadir, between the last-named place and Seydisfjord, where the cable lands. The meteorological arrangements are not complete even yet, for the reports do not conform to the established international model, either in uniformity of the hour of observation or the extent of the information transmitted, but those who have seen what the new information means for the weather map of north-western Europe, what light it throws upon the meteorological situation of the northern Atlantic, will appreciate the satisfaction that is felt with the result of the negotiations even in their present stage. Paulsen has indeed carved for himself a memorial *aere perennius* upon the winds and weather of the stormy northern island.

It is to the Lords of H.M. Treasury that we owe the realisation of this long-cherished project so far as this country is concerned. It need hardly be said that the cost of the new service is very considerable. Their lordships have undertaken to ask Parliament to increase the grant for meteorology from 15,300*l.*, the figure at which it has stood since 1882–3, by 200*l.*, and the greater part of our share of the expenses for Iceland telegrams is thus provided for.

In order that the new information may be incorporated in the daily weather report the area of the charts has been extended to a more western longitude than hitherto, and the occasion has been utilised also to take in an area as far south as Gibraltar, and to meet a wish often expressed that a barometric chart of the 6 p.m. observations of the previous evening should be given. This appears as an inset chart on the same scale as "yesterday's" 8 a.m. chart for the whole of Europe, side by side with the 8 a.m. chart for "to-day." But six o'clock observations

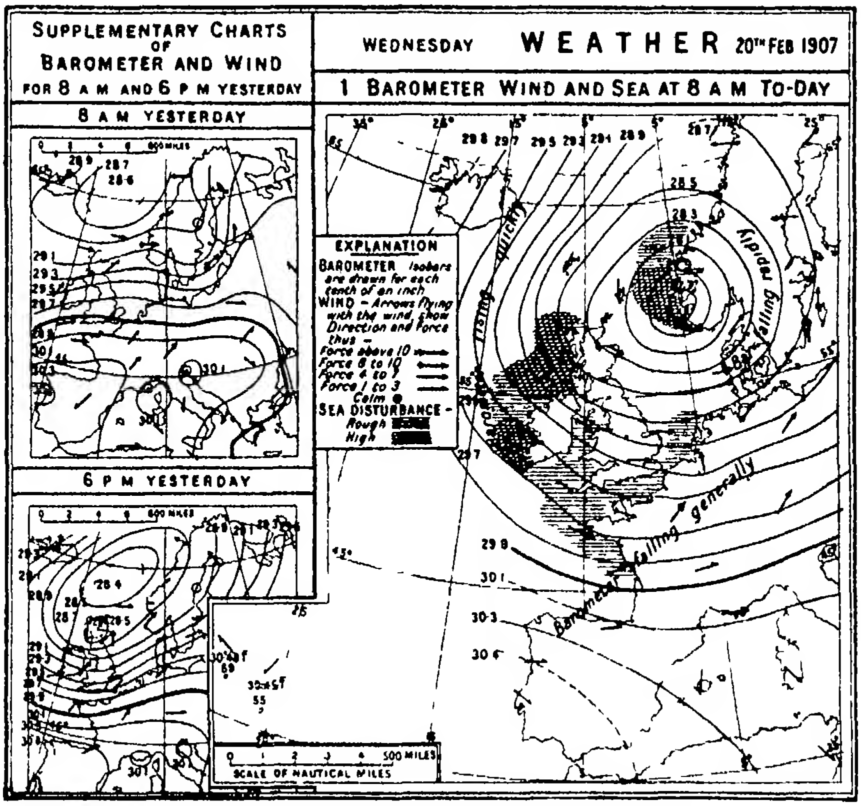
are only received by telegram from western Europe, and the eastern portion of the map would always be blank. Advantage is taken of this misfortune to get a western extension of the lower part of the 8 a.m. barometric chart, and thus provide for the observation from the Azores, for which we are indebted to Major Chaves and the Portuguese Government. It happens that the eastern point of the Azores and the western point of Iceland lie close to the meridian of 25° W., and it is a matter of importance to get observations from both these "centres of action" on the same chart. The bringing of Iceland into touch with Europe by the new telegrams emphasises the isolation of the Azores, and the chart is a pathetic appeal for the extension of the area to be reached by wireless telegraphy. But in the meantime the daily problem of drawing isobaric lines to connect the Azores pressure readings with the European and North Atlantic distribution affords an intellectual exercise which would bear comparison with some subjects of competition judged worthy of valuable prizes.

In order to represent the new arrangement of p. 2 the barometric charts for the issue of February 20 have been reproduced, completed for observations missing on the day. They show the development of the storm which caused the *Berlin* disaster at 6 a.m. on February 21.

The extensions of the daily charts have been carried out without sacrificing any of the information hitherto given on the inner pages of the daily report, except the map of weekly results which has occupied a place on p. 2 for some years. On p. 4 the table of hours of observation has gone to make space for wireless telegrams, for which arrangements have been made through the courtesy of the Lords of the Admiralty. Only two messages have appeared as yet, but they have been enough to show that the system, which needs careful organisation in order to avoid disastrous results arising from instrumental or telegraphic errors, is capable of satisfactory working.

The weekly report has been enlarged by two additional pages. The new features introduced last year have been continued. They include temperatures on the grass and in the ground, from a considerable number of stations, and observations in the upper air contributed by Mr. W. H. Dines from his new station at Pyrton Hill, Oxon., Mr. C. J. P. Cave of Ditcham Park, Mr. S. H. R. Salmon of Brighton, and Mr. J. E. Petavel, for the physical laboratory of the University of Manchester, working at Glossop Moor. To these have now been added a table of temperatures of the sea, at coastguard stations and elsewhere on all coasts. No one doubts the influence of the sea temperature upon the climate of this country, but few attempts have been made to deal with the numerical results. The tracing of the relation of sea temperature to the incidence of sea fog is the direct object of the new departure in obtaining the readings weekly instead of monthly as hitherto.

But the most important addition to the report, although it makes little show, is on the new front page. It is the first result of an attempt to deal with climatological work from the point of view of frequency distribution. The weather of the week for each of the twelve districts of the British Isles as regards warmth, rainfall, and duration of sunshine is characterised by a selection of adjectives for each element. To do this the results for the current week have to be referred to the mean values for the corresponding week, which are smoothed to give appropriate averages "for the time of year." The trouble is to define the characteristics of a week in such a way that when the weeks of a particular kind come to be counted for a season or a year, the result shall not be misleading. This seems at first sight an easy matter, but the frequency distribution of the values of the elements introduces a difficulty that is curious and interesting.



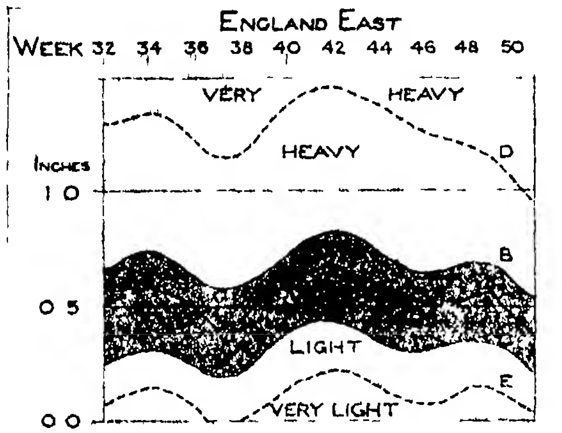
Form of the new Daily Weather Report of the Meteorological Office.

Take as an example the rainfall in a district like that of the eastern counties. The mean value for the week is by no means the most frequent value. The commonest kind of week is one with very little rainfall, and the frequency of weekly falls of successive intensities is less and less until we come to rare weeks of very heavy rainfall. The mean rainfall belongs to a group which is comparatively infrequent. Consequently, if we call a week with less than average rainfall a dry week, and it seems at first sight reasonable to do so, we shall find that in an ordinary season most of the weeks appear as dry

ones, and they are balanced by the heavy rainfall of a few wet weeks.

Thus in characterising weeks for counting it is necessary to deal with probable frequency of occurrence as well as with the relation of the week's fall to the average depth of rain. Frequency results are most easily expressed by odds. It has been sought to determine limits for a week of so-called "heavy" rainfall so that the odds are two to one against its occurrence, and the same for "light" rainfall. Further "very heavy" rainfall has been so defined that the odds are eleven to one against its occurrence, and "very light" in a similar way.

To determine the limits for these odds the weekly values for the twelve districts for the twenty-five years 1881 to 1905 have been dealt with. Smoothed mean values for each week have been obtained, and frequency results for groups of six or seven weeks, to get a sufficiently large combination of values to make the odds a reasonable representation of the probabilities of the case. Limits are then chosen so that of the whole number of rainfall values for a group of weeks, one-third are moderate, one-third heavy, one-twelfth very heavy, one-third light, one-twelfth very light. Sunshine and accumulated temperature above and below 42° are treated similarly. The adjectives selected for sunshine are "abundant" and "scanty," and for warmth "unusual" and "deficient."



Classification of Weekly Rainfall.—Portion of diagram for the District "England East" for the period from the 32nd to the 51st week. The line A is the smoothed 25 year average of the weekly rainfall. If the rainfall for any week fall within the central shaded belt, it is characterised as "moderate," if it fall outside this belt it is either "heavy" or "light"; if it fall above the dotted line D or below the dotted line E the word "very" is prefixed to the designation. The limits are so adjusted that ⅓ of the values for the 25 years 1881–1905 fall below the line C, ⅓ between the lines B and C, and ⅓ above the line B. One twelfth of the values fall above or below each of the limits D and E.

The work necessary for obtaining these limits has been very heavy, but incidentally a number of interesting points about the weekly values for the elements in the several districts and the frequency distributions have been disclosed which will be the subject of an official publication on the seasons in the British Isles.

The monthly report which began with the January number issued at the end of February, shows less change than was anticipated at one time. Negotiations were initiated with the view of making it a complete index of climatological work for the British Isles, to contain a line of data for each station contributing observations to the Meteorological Office, the Royal Meteorological Society, and the Scottish Meteorological Society. At present the three bodies collect and publish observations independently, but if a joint publication could be arranged, any person requiring climatological data would be able, by reference to a single publication, to know what information was in existence and where it was to be obtained. Unfortunately difficulties arose which could not be overcome in time, and as regards climatology the Report for 1907 is limited to the 170 stations in direct or indirect connection with the office. But Dr. H. R. Mill, the director of the British Rainfall Organisation, has expressed his willingness to contribute a rainfall map of isohyetal lines based on the monthly results for about 500 stations in the British Isles, and in the current issue this replaces the map showing rainfall values at the 170 stations which have always been regarded as too few for drawing isohyetal lines.

It ought, perhaps, to be added, as regards the daily weather report, that it is prepared and printed at the public expense, and is sent free to anyone who pays the cost of postage, wrappers, and addressing. Complaint has sometimes been made that it is not advertised as it should be, but as a matter of fact the "advertisable interest" rests with the Post Office. For the weekly report with which the monthly is included a subscription is charged to meet the cost of printing. But this report gives so compendious a statement of the weather in the British Isles, daily, weekly, monthly, quarterly, annual and average, in an annual volume of about 450 pages, that it ought to find a place in every reference library. It has now been in existence for more than twenty-five years, and its value as a homogeneous body of statistics increases with every additional year. Its weekly pages are too much like pemmican to be attractive to the general reader, but a disturbing reflection about the matter is that when its life has continued for fifty years, and the public becomes educated to appreciate its uses, there will be no means of meeting demands for the numbers which are now regarded as being merely of interest to the curious meteorologist.

TECHNICAL TERMINOLOGY

AN interesting feature of the progress of engineering science has been the gradual formation of the engineering vocabulary. Ever since the days of the early constructors there has been a steady application of fresh terms to technical practice, and it is not difficult to trace the methods by which this has taken place. But the process has operated to such an extent that what could almost be called a new language has arisen, and specimens could be quoted from the best examples of engineering literature which to scholars of a century ago would convey no meaning, though the origin of each individual term might be at once apparent to them.

Some of these terms have interesting histories by reason of the changes of sense they have passed through. The word "skid," for example, was originally the name of the buffer rope hung over a boat's side to protect it from injury. It was then applied to the shoe placed under a wheel to brake the motion of a carriage, and finally it was turned into a verb to express the vagaries of vehicles in muddy weather. "Switch" first applied in railway practice and connected with the peculiar motion of the bar so named was passed on to electrical machinery. The "salamander" is a newt of a kind supposed, according to an old legend, to be capable of living in fire. The newt, surrounded by his flames, is sometimes seen in heraldry, and from this source it was applied to certain kinds of foundry irons and crucibles. "Splay" is borrowed from architecture and in its original sense means an obliquity or bevel edge. The bevel edge is frequently used to expose some interior part, and hence the

origin of the term, which is simply a contraction of "display." The "tender," or attender, of the vessel or locomotive, and the "tender" supplied by the contractor, though of such different meanings, are derived primarily from the same Latin word, meaning "to reach out." On the other hand, the verb "fuse" comes from the Latin, meaning "to pour," and the noun "fuse," together with "fusee," from a word meaning "spindle." It is interesting to note that several words, such as magnetic, type, amalgamate, wire, and cable, have been borrowed from the technical vocabulary and applied to the language of ordinary affairs, and no doubt as mechanical appliances enter more and more into the essentials of social existence this process will be increasingly carried on. Perhaps the most interesting history of all is that of the word "pole," as used by electrical engineers. Its original is a Latin term meaning simply an axis of rotation. From this it has been applied to the particular axis on which the earth rotates, thence to the two points on that axis of special interest, to the ends of a suspended magnetic needle, and so to the points of intensity of any magnet. By analogy it has finally been applied to the terminals of an electric cell, and it is hard at the present day to see in its application—whether to the battery or the dynamo—any likeness to the original sense of the word.

Many of our oldest terms have simply accompanied the ideas they express into engineering practice from architectural, nautical, smithy, and domestic uses. Examples are swivel, lathe, pump, gauge, list (from the same root as "lust"), fish-joint, brake, and most of the terms connected with masonry construction. Some of Latin origin are interesting, *e.g.* piston (pinsere=to pound, *cf.* "pestle"), camber (camerare=to enclose or vault), filter (filtrum=felt), and vice (vitis=the tendril of a vine). Some are derived from European languages: scarf (Scand. skarf=a joint), cam (Dut. kam), bush (Dut. bus=a box), ratchet (Eng. rack), calipper (Eng. calibre), and jetty, rabbet, tunnel, pulley, quoin, from the French. Others the derivations of which have never been traced are sprocket, cotter, journal (in the mechanical sense), and spline.

Of the methods employed to-day for christening new engineering conceptions the favourite is the use of analogy. Probably more than a third of our expressions have been introduced in this way. In many the analogy is obvious—sleeper, bed, jacket, feed, booster (a U.S. colloquialism). Some are due to a likeness in appearance—crane, nose, shaft (from the arrow), groin (from its position), muff, worm, others to a similarity of function or movement—deadbeat, torpedo (the name of a fish), dog and jack (originally applied to any domestic implements of humble usefulness), pinion (from the joint of a bird's wing), valve (from anatomy), and siren (originally "one of certain sea-nymphs, who ... sang with bewitching sweetness," dictionary!). In one or two the analogy is more subtle. Thus a "washer" is really a kind of lubricant, and so was considered to resemble the film of water between the hands in washing. "Bogie" is said to be from "bogey," a fiend, the bogie coal-waggon being so called because from its suddenly turning when people least expected it, they used to exclaim that the new waggon was "Old Bogey" himself. "Steelyard," according to many dictionaries, owes its origin to the yard in London where steel was sold by German merchants, and where this kind of balance was in use.

Somewhat akin to this class are the one or two compound words we have formed—flywheel, manhole, breakwater, ingot (an ancient example, from "in" and Anglo-Saxon "géotan," to pour)—and words coined with the aid of suffixes, such as spin-dle (very old), tire (tie-r), troll-ey, tap-pet, span-ner.

Many technical terms have been formed directly from Latin and Greek words. There are old examples—pawl, carpentry, canal, cylinder, one or two of more modern date, such as electricity, annular, hydraulic, and a host of recent ones, telegraph, telautograph, microphone, vulcanite, dynamo, electrotechnics, asbestos, torque, rheostat, &c.

In general, it would seem that the terms used in construction work and machinery have been introduced mostly by the use of analogy, while the pioneers of industries—such as electrical engineering—more closely related to pure science, whose work has often been carried on in the university laboratory, have favoured the classical method in coining words.

Eight words used by electrical engineers form a class by themselves in that, instead of slowly making their way from some individual's suggestion to general recognition, they have been established by a parliament of scientific men, and have found an immediate and universal adoption. These are the electrical units. The original two—ohm and volt—were suggested by Sir C. Bright and Mr. Latimer Clark. These, together with ampere, coulomb, and farad, were made legal at the International Congress in 1881, and three fresh ones, joule, watt, and henry, were authorised by the Chamber of Delegates at the Chicago Exhibition in 1893. One striking feature of each of these words is its terseness, a virtue so often lacking to scientific expressions.

Proper names have been introduced in other ways as well. The most famous example is "macadam." Others are tramway (Outram's ways, from the inventor), galvanic, voltaic (in use before the unit was suggested), magnet, catalan (from Catalonia, the home of the catalan forge), derrick (the name of a hangman of the seventeenth century), and a queer hybrid sometimes seen in print, marconigram.

A few words have been abstracted from foreign languages. Such are quay (an old example), voussoir, turbine, barrage, tuyere (also spelt according to the dictionaries twyer, tweer, tuyer, and twier), automobile, and chassis.

About the only scientific term (outside the advertisement columns) that can properly be called an invention is the word "gas." This we owe to a Dutch chemist, van Helmont, of the sixteenth and seventeenth centuries. His explanation is that, "because the water which is brought into a vapour by cold is of another condition than a vapour raised by heat, therefore ... for want of a better name, I have called that vapour Gas, being not far severed from the Chaos of the Auntients." The word "click," formerly applied to the non-return valve, is an echoic formation, but it was not coined to describe the valve, its first use being to express the sound produced by such mechanical appliances. It seems a little strange that the engineer, whose work is so often associated with original invention, should so seldom resort to original methods in devising names for his productions.

There are still many cases of inventions that have come into general use which are badly in want of a short expressive title. Thus we have nothing better to describe the practice of signalling between mutually invisible points through the medium of the æther than "wireless telegraphy", the only name available for the class of prime mover which works by the explosion of a vapour is "internal combustion motor", and surely a handy substitute would be welcomed for "electric power supply," and some

more appropriate title for its particular vital organ than "central station." "Ferro-concrete" is certainly an improvement on "reinforced concrete," but it is a clumsy name for a material which does such important work in civil engineering. A similar case which existed until lately was the need of a substitute for "aerial navigation," but this has been most happily met by the suggested "aviation," a word which is both short in spelling and wieldy in pronunciation.

It is to be hoped that those who have to coin new engineering terms in future will follow the example of the old Dutch chemist and depart as little as possible from three-letter monosyllables. The times are growing too busy for more of the three- and four-syllabled obstructions of physicists and electricians to be tolerated.

A. H. DOWNES-SHAW.

SPORT IN CEYLON.[1]

FIFTEEN years' experience of the jungle, even though it be limited to one or two annual hunting trips, ought to suffice to make any keen sportsman (like the author of the volume before us) thoroughly familiar with the habits of all the larger forms of wild animal life to be met with in a circumscribed area somewhat smaller than that of Ireland. Mr. Storey has, however, not been content with his own great practical knowledge of the denizens of the Ceylon jungle and their ways, but has enlisted the aid of a number of his fellow sportsmen. With such an array of specialists, the book may be re-

FIG. 1.—Head of Ceylon Buffalo. From Storey's "Hunting and Shooting in Ceylon."

garded as a thoroughly up-to-date account of the sport to be met with at the present day in one of the most lovely of the islands of the East.

[1] "Hunting and Shooting in Ceylon." By H. Storey (and others). Pp. xxiii+365; illustrated. (London: Longmans, Green and Co., 1907.) Price 15s. net.

Unfortunately, this sport is nothing like what it was when Sir Samuel Baker shot and hunted in the island some sixty years ago, and if matters are permitted to go on as they are, it is the author's opinion that several of the game animals will be in danger of extermination, or at all events will be so reduced in numbers that Ceylon will cease to be a hunting-

FIG. 2.—Chital or Spotted Deer: the buck with the antlers in velvet. From Storey's "Hunting and Shooting in Ceylon."

field for European sportsmen. The two species most sorely harried appear to be the chital, or spotted deer (Fig. 2), and the elephant. As both probably represent races peculiar to the island, their extermination would be little short of a calamity.

In the case of the chital (and this also applies in a minor degree to the sambar deer) the mischief seems to be due to the killing of this beautiful animal by native hunters for the sake of its flesh, which is cured and dried. The remedy suggested by Mr. Storey is the prohibition of all trade in products of the chase within the island itself, the villagers being, however, permitted to kill such deer as they require for themselves. As regards elephants, of which the author believes there are less than two thousand in the wild state in the island, the destruction appears to be mainly due to the European sportsmen, whose exertions were formerly stimulated by a Government reward for every one of these noble animals slain.

As Ceylon elephants generally have no tusks to speak of, it is a little difficult to see why sportsmen are so keen on shooting them, and it is to be hoped that the destruction may be stopped in the near future. Wild tuskers (not improbably belonging to a race originally imported from the mainland) are now, Mr. Storey tells us, very scarce in the island, although, except in the case of "rogues," they are rigorously protected. Naturalists will be much interested in a giant race of (practically) tuskless elephants living in the Tamankaduwa district which are much larger than the ordinary Ceylon form, and commonly attain a height of between 9 feet and 10 feet.

The author's observations with regard to the wild buffalo of the northern districts of the island, and

the figures of the head he gives (one of which is here reproduced), are likewise of very great interest to naturalists, for they seem to indicate that the Ceylonese animal is a distinct local race of *Bos bubalis*. After stating that the horns are smaller and less regular in form than those of the buffalo of the Indian mainland, Mr. Storey observes that:—

"In India they seem almost all to curve boldly outward and upwards, finally curving in towards each other at the points. In Ceylon they are very irregular, and usually much shorter, though occasionally they may be more massive than Indian horns. The commonest form are those curving outwards and upwards [in] crescent form, but not with the bold, almost half-circular sweep of the Indian heads."

In this place it may be mentioned that as the author is not a photographer, he has been compelled to borrow the admirable photographs of scenery and animals with which the volume is illustrated from friends and brother sportsmen. To one of these we have already alluded; a second, showing the most beautiful of all Ceylonese animals, is reproduced as an example of the general excellence of the pictures.

Like all the big-game animals of the island, the chital is specifically the same as its Indian representative. The very fact that tigers are unknown in the island is, however, itself practically sufficient to indicate that all these animals are racially distinct from the mainland forms.

Although big-game animals naturally form the main theme, the author has something to say regarding smaller game, and likewise gives much information with regard to the physical characters and scenery of the country, while the requirements of novices contemplating a sporting trip are not forgotten. Although confessedly written from the point of view of the sportsman rather than naturalist, Mr. Storey's volume contains much which appeals to both classes, while it may likewise be commended as a delightful description of a tropical country to the general reader.

THE DEATH OF M. M. BERTHELOT.

THE tragic death of M. Marcellin Berthelot on Monday has awakened a feeling of sympathetic sorrow throughout the intellectual world. As a chemist, philosopher, a fearless exponent of scientific truth, and permanent secretary of the Paris Academy of Sciences, M. Berthelot's work and influence made him renowned among the greatest men of our time. The French nation has to mourn the loss of one of its leading citizens, and its sorrow is shared wherever knowledge and research are cherished.

Several conflicting accounts of the dramatic circumstances of M. Berthelot's death appeared in Tuesday's papers. One report states that he expired clasping the hand of his wife, who had been ill for a year and had crossed the dark river a few minutes before. According to another account, M. Berthelot was sitting in his study when the news of his wife's death was brought to him by a nurse, and he fell back in his chair dead. The *Times* correspondent states that when M. Berthelot entered his wife's room on Monday he found her dead, and the shock was so great that he returned to his study and there died suddenly himself.

France knows how to honour its illustrious men, so it is not surprising to learn that at the opening of Tuesday's sitting the French Government proposed to grant a credit of 800*l*. for a national funeral for M. Berthelot, and to adjourn the sitting as a sign of mourning. A similar expression of sympathy took place in the Senate, and the Academy of Medicine likewise adjourned its sitting. We learn from the *Times* that there will be no religious service in honour of the dead. The national civil funeral has been accepted by the family on the understanding that Mme. Berthelot should not be separated from her husband, who could not live after her.

We propose to give an account of M. Berthelot's life and work in another issue, and here limit ourselves to the expression of deep regret at his sad death, and of satisfaction that the French nation has so clearly shown its high regard for the great man it has just lost.

NOTES.

THE Goldsmiths' Company has made a donation of 10,000*l*. to the Lawes Agricultural Trust (Rothamsted Experimental Station) to be devoted to research in connection with the soil, and to be known as the Goldsmiths' Company's fund for soil investigation.

MR. A. LAWRENCE ROTCH, the founder and director of Blue Hill Meteorological Observatory, has been appointed professor of meteorology in Harvard University. The Blue Hill observations and investigations have been published for many years in the Annals of the Harvard College Observatory.

AT the annual general meeting of the Chemical Society on Friday, March 22, the president, Prof. R. Meldola, F.R.S., will deliver an address entitled "The Position and Prospects of Chemical Research in Great Britain."

MR. W. H. POWER, C.B., F.R.S., medical inspector of the Local Government Board, has been appointed chairman of the Royal Commission on Tuberculosis, in succession to the late Sir Michael Foster.

THE *Times* correspondent at Ottawa reports that on Tuesday a deputation of representative Canadians asked for a Federal grant towards the erection of a national memorial at Brantford, Ontario, in honour of Dr. Alexander Graham Bell, who invented the telephone in that city. In reply, Sir Wilfrid Laurier expressed himself in hearty sympathy with the movement.

A MINISTERIAL measure having for its object the amendment of the Patent Law was introduced in the House of Commons on Tuesday. The main purpose of the Bill is to prevent the patent laws from being used for the hindrance and suppression of British industrial development. It is proposed to simplify the procedure of compulsory licence, and instead of the applicant having to go before the Judicial Committee of the Privy Council, as at present, he will go, first of all, before the Controller and afterwards before a judge specially selected by the Lord Chancellor, who will be habitually dealing with patent cases. This method will tend very considerably to shorten the hearing of cases, because they will be dealt with by an expert judge. The Bill also provides that any applicant can go to the Controller three years after the granting of any patent and apply for the revocation of the patent on the ground that it has not been adequately worked within the United Kingdom. In addition to compulsory working, syndicates are to be enforced to deposit samples when the Patent Office requires them to do so, or else their application will be refused.

THE Geologists' Association has arranged an excursion to Plymouth from Thursday, March 28, to Tuesday,

April 2, so that members who can spend Easter in the west will be able to study the rocks and deposits of the Plymouth and Cornish areas under very pleasant conditions. The excursion secretary is Mr. G. E. Dibley, 7 Champion Crescent, Lower Sydenham, S.E.

EARL CARRINGTON, President of the Board of Agriculture, has accepted the invitation to open the second National Poultry Conference at Reading on Monday evening, July 8. The Mayor of Reading (Mr. F. Jackson) has intimated his intention to give a reception to delegates and members in the Town Hall, Reading, on that evening, when the official opening of the conference will take place.

A PRELIMINARY announcement has been issued regarding the arrangements for the fourth International Mathematical Congress, which is to be held in Rome on April 6–11, 1908. A large general committee has been formed representing the Reale Accademia dei Lincei and the Circolo matematico di Palermo. A special feature will be the organisation of lectures, or, to use the American term, colloquia, each embracing the survey of an extended region of mathematical science, and the following mathematicians have promised to lecture:—Profs. G. Darboux, A. R. Forsyth, D. Hilbert, F. Klein, H. A. Lorentz, G. Mittag-Leffler, S. Newcomb, E. Picard, H. Poincaré. The subscription is 25 francs for members, 15 francs for ladies' tickets. The treasurer is Prof. Vincenzo Reina, 5 Piazza S. Pietro in Vincoli, Rome, while Prof. G. Castelnuovo, at the same address, is general secretary of the organising committee.

THE sixtieth annual meeting of the Palæontographical Society was held at the apartments of the Geological Society, Burlington House, on March 15. The report of the council referred to the activity of students of palæontology in Great Britain at the present time, as witnessed by the number and variety of the memoirs offered for publication. Among instalments of monographs issued in 1906, one completed Mr. Reed's description of the Girvan Trilobites, and another began a new monograph of Cambrian Trilobites by Mr. Lake. The Carnegie trust for the universities of Scotland had defrayed the cost of five plates of Old Red Sandstone fishes described by Dr. Traquair. The society lost several subscribers by death in 1906, among these the Rev. J. F. Blake, who left his monograph of Cornbrash fossils unfinished. The funds had been augmented by a special sale of back stock to members, but many new subscribers were needed to raise the normal income to the amount received by the society ten years ago. Dr. Henry Woodward, F.R.S., Dr. G. J. Hinde, F.R.S., and Dr. A. Smith Woodward, F.R.S., were re-elected president, treasurer, and secretary respectively. Messrs. J. Hopkinson, W. D. Lang, H. Woods, and G. W. Young were elected new members of council.

THE Pharmaceutical Society of Great Britain has on several occasions benefited by the generosity of Sir Thomas Hanbury, whose death was announced in last week's NATURE. To the museum of the society he presented the valuable collection of ancient and modern materia medica made during many years by his brother Daniel, as well as the whole of the medicinal plants of his rich herbarium. These now occupy a special room of the museum, named the Hanbury Room. To the library of the society he presented a fine collection of scarce and valuable works on materia medica and botany, many of which are now extremely difficult to obtain. At the re-opening of the School of Pharmacy in 1903, at which he was present, Sir Thomas expressed the wish that his name should, in future, be associated with the Daniel Hanbury gold medal, which is offered biennially by the Pharmaceutical Society for original research in the natural history and chemistry of drugs, and he handed to the society securities, so that each recipient of the gold medal should at the same time be presented with the sum of fifty pounds. His generosity extended even to the School of Pharmacy, the silver medallists of each session receiving copies of "Pharmacographia" and "Science Papers," in which volumes the life-work of the late Daniel Hanbury are embodied. It is interesting to note that the munificence of Sir Thomas always had a practical aspect. His gifts were intended to help and stimulate personal effort, and were always given with discrimination after due consideration.

A SCIENTIFIC expedition under the auspices of the Royal Geographical Society, the funds for which had been found by the Alpine Club, had been arranged to explore Mount Everest from the Tibetan side. It was proposed that the party, under the command of Major the Hon. Charles Bruce, M.V.O., of the 5th Gurkha Rifles, should travel from Darjeeling north to Kampadzong, just on the Tibetan side of the Indian frontier. There it would have turned sharply and nearly due west to Kharta, from near which point the ascent was to have been commenced. Nepaul territory would nowhere have been violated. It was proposed, moreover, that the natives should have been dealt with directly by the English leaders, and that every precaution should be taken to avoid any cause of friction. The Home Government, however, refused the necessary permission. Mr. Morley, replying to a letter from Sir George Goldie, K.C.M.G., president of the Royal Geographical Society, said it was not possible, consistently with the interests of the policy of the Government for the Government of India to give encouragement or help to exploration in Tibet. Mr. Morley later in his letter made the unfortunate assumption that it was proposed to proceed "furtively" through Tibetan territory, a suggestion which Sir George Goldie repudiates very emphatically. It is conceivable that high Imperial policy should lead the Government to decide that the expedition was inexpedient, but it is difficult indeed to realise that Mr. Morley should have supposed that a body of distinguished geographers could countenance for an instant any scheme of a furtive character.

THE annual dinner of the Institution of Civil Engineers was held on March 13, when the president, Sir Alexander Kennedy, F.R.S., was in the chair. Lord Kelvin responded to the toast "Science and Literature," and is reported by the *Times* to have said it is interesting to remember that science has touched some of the noblest departments of art, for Leonardo da Vinci was one of the greatest engineers as well as one of the greatest artists of all times. Lord Kelvin also referred to the great achievements of Smeaton, the engineer of the Eddystone Lighthouse, and remarked that scientific engineering has grown up since the middle of the nineteenth century. About 1838 or 1839 the first professor of engineering in the British Empire was appointed, his chair being one established in the University of Glasgow. The demand of engineers for improved training in science has never flagged since then, and all our universities now have engineering schools. Lord Tweedmouth, in responding to the toast of "The Guests," remarked that the engineering profession

is very close indeed to the heart of the Admiralty. He referred to the services of Sir Alexander Kennedy in connection with naval construction, to the advice concerning dockyards given by Sir William Matthews, and to the distinguished work as a designer of ships of Sir William White. It is comparatively recently, he said, that the Admiralty has been so closely brought in touch with the civil engineer. But all the great works ordered by the Admiralty have been carried out by the advice of engineers.

AN unsettled type of weather prevailed over the whole of the British Islands during the past week, and the wind frequently attained the force of a gale on our coasts. A storm of more than ordinary severity was experienced in the north-west of England during the late hours of Saturday and the early hours of Sunday (March 16–17). In places on our north-west coast the wind attained the pressure of about 18 lb. on the square foot. The storm reached its greatest violence from about 9 p.m. to midnight, and afterwards the gale rapidly subsided. Unfortunately the strongest wind force was coincident with the occurrence of high water, and in consequence much damage was occasioned by wind and wave. Notwithstanding the windy character of the weather, thick fog has prevailed on our south-west coasts, resulting in the grounding of at least two large steamships, one going ashore late on Sunday night and the other in the early morning on Monday.

THE report of the Maidstone Museum, Public Library, and Art Gallery, for 1906 chronicles a very successful year, notably for the fact that presentations have been made by donors living at considerable distances from the borough. Misprints like Malay Peninsular and Osteolepus somewhat detract from the style of the report.

THE blue jay (*Cyanocitta cristata*), the killdeer plover (*Ægialitis vocifera*), and the bluebird (*Sialia sialis*) form the subject of the last three of the excellent series of illustrated leaflets issued by the (U.S.) National Association of Audubon Societies.

NEW or little-known perch-like fishes in the collection of the academy and the land-shells of the Ozark Mountains of Arkansas and Missouri form the subjects of papers in the issue of the Proceedings of the Academy of Natural Sciences of Philadelphia for December last.

AT the conclusion of an exhaustive memoir on the development of the common ring-snake (or grass-snake) published in vol. lxxxvi., part i., of the *Zeitschrift für wissenschaftliche Zoologie*, the author, Mr. Theodor Viefhaus, institutes a careful comparison to show in what respects the early stages of a number of other reptiles differ from those of the species described. The preamnion and the primitive groove are among the structures in which such differences are in many cases very notable.

THE report of the Royal Scottish Museum, Edinburgh, for 1906, contains a well-merited tribute to the services of Dr. R. H. Traquair, who retired in August last after a thirty-two-years' tenure of the post of keeper of the natural history department. Among the gifts received during the year, mention may be made of a giraffe from the Quasaengeshu plateau, British East Africa, presented by Lord Hindlip. This should be of the same race as the large mounted pair exhibited in the Natural History Museum.

TO the *Naturalist* for March, Mr. Arthur Whitaker contributes further notes on the breeding habits of British bats, and more especially the ordinary bat, or pipistrelle. July, it appears, is the great month for breeding among British bats, and it has been demonstrated that in the pipistrelle the period of gestation is not less than forty-one days, and is probably of about six weeks' duration. At birth the young pipistrelle is flesh-coloured, totally blind, and naked except for a few hairs on the muzzle. Fur begins to show in about a week, and soon after imparts a golden tinge to the back and a more silvery tint to the under parts. Even when only a few days old the young bats might be seen hanging altogether apart from their parents, but up to the thirty-first day (when the last died) they did not attempt flight on their own account.

INSECTS associated with or related to the Mexican cotton boll-weevil continue to engage the attention of the U.S. Bureau of Entomology, parts iii., iv., v., and vii. of Bulletin No. 63 being devoted to them. The most important of these is the Texan ant *Solenopsis geminata xyloni*, which attacks the boll-weevil in sufficient force to effect an appreciable diminution in its numbers. An examination made last autumn of 300 fallen squares and bolls of cotton collected indiscriminately showed that 40 per cent. of the weevils (in all stages) by which they were infested had been killed by the ants. The ant, which is widely distributed in Texas and western Louisiana, and may be found on totally different types of soil, is undoubtedly of considerable benefit as an established enemy of the weevil throughout nearly all the area at present infested by the latter.

A SUGGESTION for obtaining colour-correct photographs of flowers and natural objects without the use of colour screens is made by Mr. J. H. Crabtree in the current number of the *Photographic Monthly*. The method consists in using flashlight powders containing lithium and strontium compounds. It should be instructive to compare results obtained by photographing parrot tulips in this way with photographs taken with a carefully selected colour screen.

IT is at first somewhat surprising to note the great variety of fruits recommended for cultivation in Ceylon in a Circular (vol. iii., No. 14) issued from the Royal Botanic Gardens, as the lists include such European fruits as the pear, cherry, and blackberry, as well as tropical and sub-tropical productions. This is possible owing to the variations in climate at different elevations, and the author, Mr. H. F. Macmillan, arranges his lists according to a vertical scale. A second year's experimental trial of cotton cultivation at Maha-iluppalama forms the subject of another Circular (No. 18).

IN the Kew Bulletin (No. 2) is published the nineteenth series of "Diagnoses Africanæ," containing new species of Hibiscus, Adenium, Strophanthus, and a new Landolphia from Delagoa Bay, also the twelfth series of "Decades Kewenses," including an Aconite from Sikkim and two species of Vitex from Borneo. A collection of marine algæ from the Chatham Islands, from which two new species were obtained, is described by Mr. A. D. Cotton, and Mr. J. M. Hillier contributes some notes on economic products imported into Liverpool. The possibility of growing *Catalpa cordifolia*, allied to the ornamental *Catalpa bignonioides*, for timber in this country is answered in the negative by Mr. W. J. Bean.

THERE is a chance of unintentional misrepresentation or exaggeration when reports of scientific discoveries are presented by non-scientific writers, a notable instance having recently occurred in certain accounts of plant experiments made by Mr L. Burbank. In these circumstances an authentic account by a competent critic was desirable, and such is found in the article contributed by Prof. Hugo de Vries in the *Century Magazine* for this month. While it has happened that owing to the neglect of European records horticultural productions have been incorrectly described as new in America, there is no doubt as to the novelty of many interesting sports collected and developed by Mr Burbank; the Bartlett plum, thornless brambles, and the scarlet Californian poppy attracted Prof. de Vries's notice as he was on the look-out for possible mutations. But in so far as statements have been made that the practical results are opposed to scientific theories, such as the laws of Mendel, Prof. de Vries concludes that Mr Burbank has not studied these theories, being chiefly concerned with the practical value of his varieties.

MR W. E. COLLINGE, head of the department of economic zoology of the University of Birmingham, sends us particulars of a new gooseberry pest identified by him as a result of recent work upon the genus of mites known as Eriophyes, of which *E. ribis* (Nalepa), causing "big bud" on black currants, is perhaps the most familiar example. Mr Collinge has long held the opinion that many other fruit trees would ultimately be found to possess these mites. During the past week he has found a mite of the genus Eriophyes in a number of gooseberry cuttings received from Evesham. The species, which appears to be a new one, is rather longer than *E. ribis*, and a full description of it will be published. It is proposed to name the mite *Eriophyes grossulariae*. The purpose of the present communication is to direct the attention of all gooseberry growers to the new wood of their trees, upon which the buds appear to be dead or dying up. Such should be cut off and immediately destroyed by burning.

THE Phillips Academy, Andover, Mass., which claims to be "the only preparatory school in the world that possesses a fine museum and department of archæology," has issued two Bulletins prepared by Mr W. R. Moorehead, the curator of the Peabody Museum in connection with that institution. The greater part of the first is devoted to an account of the exploration of the Chaco group of Pueblos in New Mexico, from which many specimens of a familiar type were disinterred. More novel and interesting is the description of Flint Ridge, which in the opinion of the author "furnished more material for aboriginal usages than did any given area in the United States. Arrows and knives made of its multicolored chalcedony and chert are found in western New York and far down the Mississippi." The second Bulletin is a study of the "so-called gorgets," a class of perforated articles made of slate, so named because they are generally supposed to be neck ornaments. Various uses have been suggested for these curious objects—that they were ornaments or decorations without religious significance; that they were used as beads, buckles, or buttons; as weights or spindle whorls; for games; or, finally, as amulets. The authors, after a review of these various suggestions, conclude that they were used as neck ornaments with some religious significance, as "bracers," or wrist-protectors in using the bow, and for twine-twisting or netting; but the subject is far from being exhausted, and their origin and use are still obscure. On the whole, these pamphlets are a welcome indication of the importance of anthropological studies in the United States.

THE Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. l., part iv.) contains a paper by Mr J. G. Johnstone on the stability of submarines. Accidents have happened to several navigable submarine vessels, and as these vessels were of the type known as the diving submarine there has been much discussion regarding the stability of vessels of that special type. The author gives results of investigations into the static stability and the stability of motion of a special case. As the speed of future types is to be made greater, the more important becomes the necessity for such investigations, and it is urged by the author that tank experiments would be of special value.

THE coal-dust problem is discussed by Mr James Ashworth in *Engineering* of March 15. Dust of any sort is a source of danger in every mine that produces fire-damp. The records of various explosions show that the only certain arrestment of a coal-dust explosion occurs when there is an excess of dust, which smothers the flame through lack of air to maintain combustion, and that the most favourable atmosphere to encourage the spread of an explosion is that which contains a maximum percentage of water vapour and a normal quantity of floating coal-dust. Protection against disaster is therefore limited to safe lighting and safe blasting. The watering of dusty roads, which is compulsory in Westphalia, is no deterrent to wholesale devastation.

IN the Journal of the Franklin Institute (vol. clxiii., No. 2) there is an exhaustive article by Mr I. S. Sperry on the manufacture of rolled sterling silver. Within the past twenty-five years this manufacture has undergone a remarkable change. Instead of being confined to the wealthy, sterling silver is now found in very general use, the reason being, not the reduction in the price of silver, but in the cost of manufacture due to the use of rolled sheet metal. Articles which formerly were made from rods are now made by stamping from sheet-metal, with the employment of modern machinery in place of hand labour. The various operations employed in the production of the sheet-metal which is the foundation of the manufacture of modern sterling-silver ware are described and illustrated by Mr Sperry.

THE *Geographical Journal* for March contains a valuable discussion of the existing observations of the heights of the central African lakes and mountains, by Captain T. T. Behrens, R.E. The surfaces of the three principal African lakes having been connected with each other and with the Indian Ocean by a complete set of trigonometrical operations, Captain Behrens compares the results with earlier determinations by hypsometer and barometer, and he also deals with the heights of the principal peaks, which have been connected trigonometrically with more or less accuracy. A list of heights, based on mean sea-level at Mombasa, and carried to Lake Victoria by Uganda railway levels, is compared with means from travellers' observations, and also with values obtained by Dr Kohlschutter, who employs a modification of the usual formula which allows for the influence of local climatic factors. The results seem to indicate that the barometric and hypsometric observations give closer approximations to the truth than is generally supposed.

IN NATURE of February 8, 1906 (vol lxxiii, p 352), a brief account was given of the proceedings of the meeting of the International Meteorological Committee in Innsbruck in September, 1905 The k k Zentralanstalt für Meteorologie und Geodynamik has now published a volume of 154 pages (Vienna W Braumuller, 1906) which contains a full report of these proceedings and much other valuable information Thus, in addition to the reports of several special committees which dealt with cloud classification, earth magnetism, and atmospheric electricity, a valuable series of appendices is given consisting of communications to the commission relating to many different subjects of interest and importance which were considered The text of this volume is in the German language, but a resolution of the commission was passed at the fourth meeting to the effect that both English and French editions should be subsequently published

SINCE the discovery and practical application in Germany of processes for producing "synthetical" indigo, the planters of India have made strenuous efforts to improve their methods of dealing with the natural material In this connection, the report for the year 1906-7 of the work of the Indigo Research Station Sirsiah of the Bihar Planters' Association, which has just been issued presents interesting reading * The report, written by Mr Cyril Bergtheil is divided into three sections, namely, laboratory work, manufacture and agriculture Perhaps the principal point that merits notice is that relating to the discrepancies between the results obtained by a number of different analysts who were entrusted with the examination of the same samples of indigo The same material was analysed at Calcutta, Bradford Manchester, and Berlin, and results were returned by the different analysts varying from 71 per cent to 96 per cent of indigotin The question of the analysis of indigo has recently been the subject of several papers but it is by no means yet decided which is the best and most trustworthy method for the purpose, although Mr Bergtheil confidently recommends the processes he has adopted The question of analysis is one of great importance, and it is clear that no real progress in indigo research can be made until it is satisfactorily settled What appears to be a decided improvement in indigo culture is described in the report with reference to the germination of the seed of the Java plant It would appear that this seed does not usually germinate satisfactorily owing to its possessing a "cuticle" which is impermeable to water To remedy this, it has been found advantageous to soak the seeds for half an hour in concentrated sulphuric acid, and subsequently to wash with water very thoroughly before sowing Good seed treated in this way has been found to germinate to the extent of 100 per cent The report also deals in detail with the work done on the farms established recently to supply seeds of the Java indigo plant

UNDER the title "A Junior Course of Comparative Geography" Messrs G Philip and Son Ltd, have just issued Course A of the "Progressive Course of Comparative Geography," reviewed in the supplement to NATURE of March 14 (p v) The price is 2s 6d net The same publishers have sent us a copy of the seventh edition, revised to date, of their "Handy-volume Atlas of the World," by Mr E G Ravenstein The price of this compact little volume is 3s 6d

IT is clear from the thirty-seventh annual report of the Natural Science Society at Wellington College that the society is in a flourishing condition There is a balance in hand of 113l for which it is to be hoped, some useful scientific purpose will be found The Saturday scientific lectures, which have become a feature of the work of the society, were continued during the Michaelmas and Lent terms The meteorological report of the society is as complete as usual

THE most recently published parts of the Transactions of the Royal Society of Edinburgh are vol xli, part iii, for the session 1904-5 and vol xlv, part i, for the session 1905-6 The papers included in these publications cover those read before the society during a period of about eighteen months The contents are very varied, and amongst subjects of special interest in the first-named part may be mentioned the fresh-water plankton of the Scottish lochs, the structure of the series of line- and band-spectra, the hydrodynamical theory of seiches, and the plant remains in the Scottish peat mosses In the second of the publications are, with others, papers on the varying form of the stomach in man and the anthropoid ape the normal temperature of the monkey and its diurnal variation, and on the effect of changes in the daily routine on this variation the elevation of the boiling points of aqueous solutions of electrolytes and the relationship between concentration and electrolytic conductivity in concentrated aqueous solutions

THE report for 1906 of the Agricultural Research Association for the north-eastern counties of Scotland is devoted almost entirely to an account by Mr T Jamieson of work on the utilisation of nitrogen in air by plants in continuation of the observations described in NATURE a year ago (vol lxxiii, p 531) Mr Jamieson claims that he has obtained further evidence of the absorption of nitrogen from air by plants but the views of scientific experts upon the doctrine he desires to establish were stated in the notice of the previous volume We have not the space available to enter into a detailed statement of Mr Jamieson's position and point out the unsound foundation upon which it rests We must therefore refer our readers to the volume just published for particulars of experiments which Mr Jamieson puts forward as material for a new agricultural science The criticisms of his views expressed at the York meeting of the British Association last year, and also in other places, are dealt with at the end of the present volume

OUR ASTRONOMICAL COLUMN

COMET 1907a (GIACOBINI) —The following elements and ephemeris have been computed for comet 1907a by Herr M Ebell from places observed on March 9, 10, and 11 —

Elements

T = 1907 March 23 5206 Berlin

$$\left.\begin{aligned} \omega &= 319^\circ\ 34'\ 3 \\ \Omega &= 97^\circ\ 40\ 0 \\ i &= 141\ 20\ {}^{\cdot}5 \end{aligned}\right\}\ 1907\ 0$$

log q = 0 31176

Ephemeris 12h (M T Berlin)

1907	α (h m)	δ	Brightness
March 19	6 40	−9 26	0 81
23	6 33	−6 22	0 74
27	6 27	−3 34	0 67

Brightness at time of discovery (mag 11 0) = 1 0

From the above it will be seen that the comet is travelling through the constellation Monoceros towards the northern part of Orion, and that its brightness is decreasing fairly rapidly At present it crosses our meridian at about 6 30 p m, and sets at about 11 30 p m

In No. 10 (March 11) of the *Comptes rendus* M. Giacobini states that the comet is a round nebulous object of 20″ diameter, having an eleventh-magnitude nucleus, and, apparently, a tail in position-angle 180°.

SEARCH-EPHEMERIS FOR COMET 1900 III (GIACOBINI).—In No. 4150 (March 7) of the *Astronomische Nachrichten* Herren Abold and Scharbe publish a search-ephemeris, extending from March 5 to April 2, for comet 1900 III. As the probable time of perihelion passage is very uncertain they give three ephemerides, in which T is taken as May 5, June 8, and July 13 respectively, June 8 being considered the most probable. No perturbations have been taken into account, and as on March 13 the calculated brightness was but 0·4 of that observed on February 15, 1901, it is feared that the hopes of re-discovering this object are but small.

SOLAR OBSERVATIONS AT CATANIA.—In No. 2, vol. xxxvi., of the *Memorie della Società degli Spettroscopisti Italiani* Prof. Riccò publishes the summarised results of the solar observations made at the Catania Observatory during the third and fourth quarters of 1906. There was a marked decrease in the daily frequencies of spots, faculæ, and prominences during the fourth quarter as compared with the third, which, however, showed an increase in the daily frequency of all three phenomena on comparison with the results of the second quarter.

INTENSIFICATION OF "CONTRAST" BY MEANS OF A POLARISCOPE.—Some interesting suggestions concerning the intensification of contrast in astronomical observations by the employment of the polariscope, are made by Dr. Felix Biske in No. 2, vol. xxxvi. (February) of the *Memorie della Società degli Spettroscopisti Italiani*.

Dr. Biske points out that under certain conditions of the atmosphere and positions of the body observed it is possible to polarise the light received so that the ratio of the amount of light from the body to that of the sky is increased, thus rendering the details of the observed object more easily visible. It is suggested that by this means the observation of the corona whilst the sun is not eclipsed may be facilitated, and that comets, the light from which often shows a fair amount of polarisation, may be observed more easily. Similarly the planets Mercury and Venus and the moon may under certain conditions be observed when by the ordinary method this would be very difficult or impossible.

THE MINOR PLANET (588) [1906 T.G.].—In No. 4155 of the *Astronomische Nachrichten*, Dr. Bidschof gives a new set of elements and an ephemeris for the minor planet (588), which it will be remembered is remarkable for its extraordinary aphelion distance, lying an astronomical unit beyond the mean distance of Jupiter. The elements are based upon observations made during 1906, and differ somewhat from those previously published by Dr. Berberich. This interesting object will be unfavourably situated for northern observers for several years, but it is to be hoped that the southern observatories will endeavour to keep it under observation.

The present magnitude of the planet is about 15·0, and it was re-observed by Prof. Wolf in a position in fair accordance with Dr. Bidschof's ephemeris, on January 22.

RESEARCHES IN STELLAR PHOTOMETRY.—Under the title "Researches in Stellar Photometry during the Years 1894 to 1906," made chiefly at the Yerkes Observatory, the Carnegie Institution of Washington has published a beautifully prepared and illustrated volume containing the results of Mr. J. A. Parkhurst's careful and systematic study of twelve variable stars having long periods and faint minima. The observations were carried out first with a 6-inch reflector, then with a 12-inch refractor, and finally with the 40-inch refractor of the Yerkes Observatory. Argelander's method of comparison was employed, and during the later years the comparison stars were carefully standardised with a Pickering equalising wedge-photometer. In addition to the tabulated results giving the individual observations of the variable and of the comparison stars, Mr. Parkhurst gives the complete light-curve for the period of observation, of each variable, and a plate reproduction of a photograph showing the region surrounding each star, the majority of these are on the scale of 1 mm. = 13″·5 (approx.). As an example of an attack on an important phase of the sidereal problem, the volume is almost unique in the wealth of detail it contains and the lavish manner in which the results are presented.

MARSUPIALS OR CREODONTS?

THE vexed question as to the real affinities of the marsupial-like carnivores of the Santa Cruz beds of Patagonia has once more been brought prominently to the front by the appearance of a memoir on their osteology and dentition in the fourth volume of the reports of the Princeton Expedition of 1896–9 to Patagonia. In this memoir the author, Mr. W. J. Sinclair, takes up a very decided position, remarking that these so-called sparassodonts (as represented by Prothylacinus, Borhyæna, Amphiproviverra, &c.) possess a number of characters either peculiar to marsupials or common to that group and only a few other orders. These, it is urged, will convince the reader that sparassodonts are true carnivorous marsupials, not worthy of even separate subordinal rank. Mr. Sinclair goes, however, even farther than this, and considers himself justified in including the Patagonian carnivores in the same family group as the existing Tasmanian pouched wolf or thylacine, which he separates from the Dasyurida under the designation of Thylacinidæ (or Thylacynidæ). It is added that, "although there is sufficient similarity in structure to warrant placing the Patagonian and Tasmanian thylacines in the same family, it must not be inferred that the existing genus is the direct descendant of its extinct South American forerunners. The study of the group has failed to show a closer relationship than probable descent from a common Santa Cruz ancestor. While retaining the fundamental family characters, both lines have diverged, and in some respects the Santa Cruz forms are more advanced than the existing genus."

Among the structural features on which the author relies as evidence of the marsupial nature of the Patagonian fossils are the dental formula, the reduction in the number of successional cheek-teeth, the inflection of the angle of the lower jaw, a number of peculiarities in the conformation of the skull, and the perforation of the transverse process of the seventh cervical vertebra by the arterial canal. On the other hand vacuities in the bony palate and epipubic (marsupial) bones, both of which are characteristic of most existing marsupials, are wanting.

As regards the dental formula of the cheek-teeth, this, in the opinion of Dr. J. L. Wortman (*Amer. Journ. Sci.*, vol. xi., p. 336, 1901) and the present writer, is identical in the sparassodonts, carnivorous marsupials, and creodonts, and is therefore of no importance, except to indicate the mutual relationship of all these three groups. By all zoologists of the present day it is, I believe, admitted that the reduction of the replacing teeth in modern marsupials to a single pair of premolars in each jaw is a secondary feature, so that the presence of a larger number of such teeth in the sparassodonts indicates the more primitive nature of those mammals, and one allying them to creodonts. Some of these sparassodonts differ, however, from all the more typical representatives of the latter group in having four, in place of three, pairs of upper incisor teeth, and thus resemble carnivorous marsupials; but since this feature is likewise regarded by Dr. Wortman (*op. cit.*, p. 335) as of secondary origin, it is no bar to the derivation of sparassodonts from creodonts, while it indicates that the latter are not likely to be the descendants of the former. As the author himself regards the presence of vacuities in the palate and the inflection of the lower jaw as being likewise secondary features in marsupials, all these lines of evidence point to the conclusion that creodonts are the most primitive of the three groups under consideration.

It follows from this, on the author's assumption that the Patagonian carnivores are thylacines, that palatal vacuities have been independently developed in several families of existing marsupials, and a similar argument will hold good with regard to the reduction of the

successional cheek-teeth. Such independent developments seem, however, in the highest degree improbable.

The fact that in the existing thylacine the epipubic bones do not ossify may perhaps be held to indicate that a similar condition obtained in the Miocene sparassodonts, although such a loss is improbable in these early forms, more especially as one of them is considered to have been partially arboreal. Be this as it may, it is quite clear (unless we again admit a series of independent developments) that the sparassodonts cannot be regarded as belonging to a grade of marsupials in which these bones had not yet been evolved, because we find them fully developed in the Oligocene opossums.

The most important argument of all against the marsupial nature of these Patagonian carnivores is, however, one derived from the nature of the enamel of their teeth, which does not appear to have come under the author's notice. According to the observations of Mr. C. S. Tomes (Proc. Zool. Soc. London, 1906, p. 45) the enamel of the sparassodont teeth is histologically identical with that of creodonts and modern carnivores, and quite unlike that of all marsupials.

Seeing, then, that sparassodonts, which are later in age than certain undoubted marsupials, differ from existing carnivorous marsupials as a whole in the minute structure of their dental enamel, by the lack of epipubic bones, the absence of unossified spaces in the floor of the skull, and apparently by the larger number of successional premolars, it seems improbable that they are really members of that group. On the other hand, they resemble creodonts in their complete palates, in the absence of epipubic bones, and to a great degree as regards the replacement of the cheek-teeth, while it is highly probable that many of the cranial characters referred to as being marsupial may really be primitive ones. The one essentially marsupial feature is the presence, in some cases, of four pairs of upper incisors.

On the whole, therefore, it seems advisable to regard the Patagonian carnivores as creodonts showing a tendency (it may or may not be parallelism) towards the marsupial type. That creodonts, sparassodonts, and carnivorous marsupials are, however, related groups, and that the former are not improbably the oldest and most primitive of all known mammals (perhaps directly descended in "Gondwanaland" from anomodont reptiles), appears almost certain. And it may further be suggested that these early creodonts have developed in one direction towards the sparassodont type, in a second towards the carnivorous marsupials, while in a third line they have developed into the modern Carnivora. Beyond this it seems at present impossible to go.

It should be added that the present writer was at one time of opinion that sparassodonts were marsupials.

R. L.

THE GODS OF HEALING OF THE EGYPTIANS AND GREEKS.

DR. R. CATON recently delivered a short course of lectures on the above subject in connection with the Institute of Archæology at the University of Liverpool. After referring to the works on medicine written by Athosis, the son of Menes, and also by the Pharaohs Usaphais and Semti in very early times, he described briefly the cults of Isis, Serapis, Thoth, and I-em-hotep, and gave a short account of the temples in which the work of healing took place. Of these, quite the most important was the temple of I-em-hotep at Memphis. All these shrines of healing are destroyed, excepting the small temple of I-em-hotep on the island of Philæ. Dr. Caton referred to the large number of medicinal agents used by the Egyptians, and to the practice of incubation or temple sleep. In the temples of Isis and Serapis, and probably in the more important shrines of I-em-hotep, the sick slept in or adjacent to the temples in the belief that the god would manifest himself to them or speak to them in dream or vision, and suggest the method of cure. Such dreams or visions were interpreted by the priest, and the treatment adopted was supposed to be founded in accordance with them. Sometimes no dream was vouchsafed, or no interpretation could be drawn from it bearing on the disease; in that case the priest did the dreaming. The priests of I-em-hotep had also to do with the embalming of the body, and, partly through this, they acquired a considerable knowledge of anatomy, and learned certain facts regarding the circulation of the blood. Some of the medical papyri contain remarkable details as to the blood-vessels and the movement of the blood; probably the Greeks obtained from them all the knowledge they possessed on this subject.

In Greece and Magna Græcia various gods and demi-gods were supposed to possess medical powers. Men Karou at Laodicea was a health god much in vogue in Asia Minor, and a large medical school was associated with his temple.

Apollo, Amynos, Asklepios, Hygeia, Amphiaraus, Trophonios, Aphrodite, and the Chthonic deities Pluto, Demeter, Persephone, and others of lesser importance were eminent for their health-giving efficacy in Greece. Of these the cult of Asklepios was by far the most important. At numerous splendid temples, rich with the finest products of Greek art, the worship of the god and the cure of the sick were carried on for centuries.

Epidaurus was perhaps the most important of these shrines; it was a centre from which the cult was disseminated through other parts of Greece and the colonies. Trained priests, and also the sacred serpents, which were believed to be the incarnation of the god, were sent thence to carry on the work of healing in such places as Athens, Corinth, Delphi, Pergamon, Cnidos, Rhodes, Cos, and many other cities.

In all incubation was the initial step and the guide as to treatment. Probably the people would have had no confidence in the methods used but for the belief that the god himself had suggested them; even the priests themselves may in part have been believers. Many of the priests were physicians, who in the course of ages compiled much valuable information; they possessed useful methods of treatment in regard to rest, to diet, to the remedial use of exercise and of baths, and medicines. The ritual was beautiful and impressive, and their practice seems to have been humane in all respects except one. The god and his priests must have no dealings with death or with birth. If either were impending, the unhappy patient was at once expelled from the holy precinct. Not until the time of the Antonines were the special "houses of Birth and of Death" provided external to the precinct for these two classes of sufferers.

At Cos the influence of Hippocrates seems to have been directed always towards the effacement of superstition and the founding of medicine on truth and fact alone. His influence seems to have had no effect as regards the practice of incubation, for it continued through Pagan and into Christian times.

As the East was Christianised the cult of Asklepios was the last to disappear, but the healing went on in the same manner (excepting that the sacred serpents seem to have vanished). The Panagia, or a Christian saint, took the place of Asklepios, and incubation went on unchanged. The practice spread over large parts of Europe, and was even to be found in England during the Dark Ages.

It still exists on many of the islands and on some of the shores of the eastern Mediterranean. Details of the ancient and modern practice of incubation are to be found in the writings of Dr. Rouse and Miss Hamilton, who have both devoted close attention to this curious usage.

An interesting feature of the life of these ancient health resorts was the provision made for the entertainment and amusement of the sick visitors. A great open-air theatre was always at their disposal, where the works of the Greek dramatists would wile away many an hour of weariness and languor.

In later times an Odeon, or music-hall, was sometimes provided. The races of the stadium and the exercises of the gymnasium and palæstra would be good for many of the youthful convalescents to take part in, and amusing for others to witness. The health temples were usually placed in elevated situations, where pure mountain breezes would invigorate the visitant, and pure, fresh water was

abundant. Beautiful country scenery, as well as masterpieces of architecture and art of other kinds in the precinct, would attract his attention, awaken his interest, and tend to prevent him dwelling too much in thought on his own ailments. There can be little doubt that the sick were in general much benefited by their residence at the Asklepieia of ancient Greece.

THE SNOW-PEAKS OF RUWENZORI.

THE paper read by the Duke of the Abruzzi at the special meeting of the Royal Geographical Society on January 12, of which a short report was given in NATURE for January 17 (p. 282), has been printed in full

The paper as printed supplies information as to the basis for the determination of the heights of the snow-peaks, fourteen of which were climbed by the Duke. With one exception, they all depend on observations with the mercurial barometer referred to Bujongolo as a lower station, which again was linked with Fort Portal, and through this with Entebbe, by barometer readings as nearly simultaneous as possible. Some of the heights above Bujongolo were also fixed by Captain Cagni by vertical angles, the results agreeing closely with those of the barometer observations. The Duke's figures are mostly about 100 feet to 200 feet in excess of those derived from Captain Behrens's triangulation, and it is possible that when the altitude of Fort Portal above the Victoria lake has been

The Highest Peaks of Ruwenzori.

in the February number of the *Geographical Journal*, accompanied by a small selection of Signor Sella's striking photographs. One of these, showing the highest summits of the range, we are enabled to reproduce herewith by the courtesy of the editor of that journal. The twin peaks in the background on the left are the culminating points of the whole range, named by the Duke after the queens of Italy and England. They belong to the group of peaks named by him Mount Stanley, while the remaining summits shown in the photograph form together the group to which the name Mount Baker is applied, the highest point of which is King Edward Peak (the most central in the picture). As is well shown, the two *massifs* (like the whole six which constitute the snowy portion of the range) are separated by a comparatively deep depression, to which the name Scott Elliot Pass has been given by the Duke.

fixed trigonometrically, a small correction will have to be applied throughout. The general accordance in the heights of the six separate *massifs* is somewhat striking, none falling below 15,000 feet, while the highest point of all is only 16,816 feet. None of the peaks offers any serious difficulties to the climber, for the Duke says that the obstacles met with during the ascent of the Queen Margherita peak could have been avoided by another route.

The Duke's conclusions as to the geological history of the range were summarised in our former article, but it may be added here that attention is directed to the probable existence of internal fractures traversing the whole range in a generally north-south direction, which would account for the separation of the several groups of summits. The general hydrographic system can be grasped from the

rough sketch accompanying our former report, which shows how the Bujuku derives its supplies from a much larger part of the snowy area than does the stream hitherto considered to be the upper course of the Mobuku. The Duke was not able to define so clearly the drainage on the side of the Semliki, but he says that the streams flowing west from the four main passes leading in that direction all unite to form the Butagu, the valley of which has been the usual line of approach to the snows on this side. In the Ice age the whole of the valleys of the Bujuku, Mobuku, and Mahoma (south of, and parallel to, the Mobuku) were filled with glaciers of the first order, which must have united and descended the Mobuku valley for some distance. Similarly, glaciers descending from the three southernmost of the groups must have united to form a great westward-flowing ice-stream. At present the lowest point reached by a glacier (that which feeds the Mobuku) is 13,682 feet. The permanent snows are included in a circle ten miles in diameter.

It should be mentioned that the Royal Geographical Society proposes to apply the Duke's name to the most southerly of the snowy *massifs*, instead of that of Thomson, who himself never saw Ruwenzori, important as his work was for the general opening up of this part of East Africa.

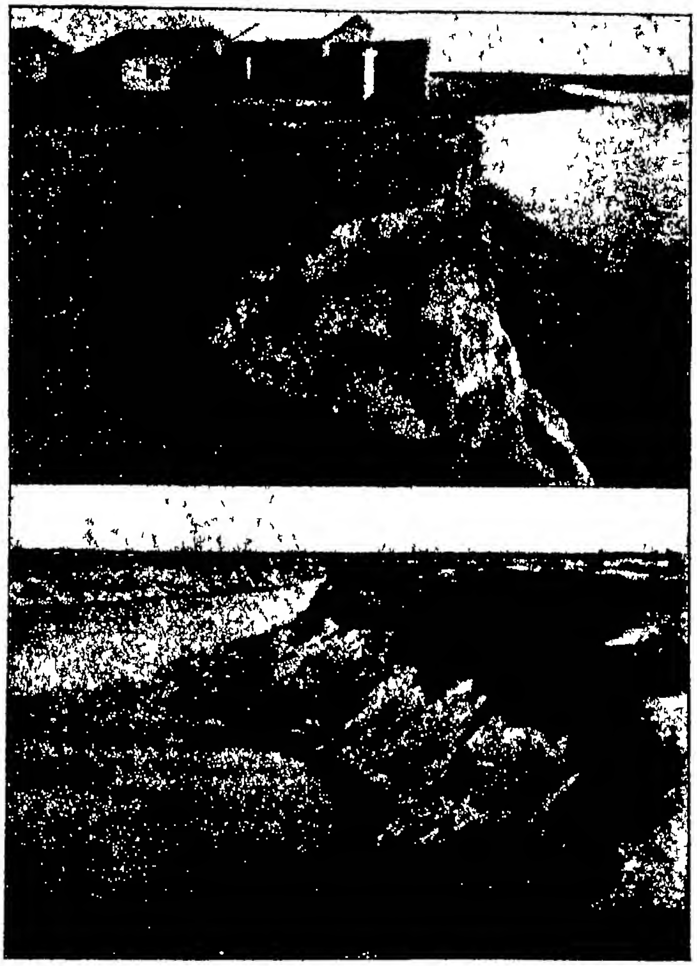
MAN AND SUPERMAN.

MR. ARTHUR J. DAVIS, of the U.S. Reclamation Service, describes in the *National Geographic Magazine* for January the startling changes that are now taking place in the region north of the Gulf of California. For 150 miles from the apex of the gulf, an area of delta and alluvium and old sea-bottom extends to the north-west between the mountains. The upper part of this basin forms the Imperial Valley, and lies in the territory of the United States. Below the Mexican frontier, the Colorado River, emerging from the hills, has built up a huge alluvial barrier above the level of the land to the north of it. This in its growth cut off the head of the ancient gulf, and led to the gradual disappearance of the water by evaporation.

The Imperial Valley thus came into existence, with part of its floor 300 feet below the level of the adjacent sea, and a variable lake without an outlet, the Salton Sink, at its northern end. From time to time the Colorado River, in seasons of flood, has diverted itself from the elevated delta into the Salton Sink, and the lake has grown in consequence. At other times it has banked itself out of this region, has flowed again into the Gulf of California, and has left its temporary northward-running channels, the Alamo and New Rivers, practically dry and sand-filled.

The ease with which the northern lowland could be irrigated led to the formation of a canal about seven years ago. Its mouth, however, became silted up, and a spot was then selected above a steeper slope, where the velocity of the water leaving the Colorado was greater and more effective. In May, 1905, however, the first serious flood-waters deepened this new channel, and supplied far more water northward than was required. The "Salton Sea" rose rapidly, and the Southern Pacific Railroad along its margin was equally rapidly moved to higher ground. Striking alterations occurred in the old valley-floors as they were invaded, and the cataract of the New River, cutting its way back to the frontier town of Calexico, flowed there in a channel 45 feet below the level of the farm-lands. The peril became so great in 1906 that a huge dam was constructed on the delta, in order to compel the Colorado River to return to its former route into the Gulf of California. Mr. Davis's account of this titanic struggle—the printer makes him speak of "herculanean efforts"—forms very interesting reading. The dam having been completed last November, it was estimated that the enlarged "Salton Sea" would dry up in about twelve years; but in December the water of the Colorado worked its way round the dam, and resumed its rush into the Imperial Valley.

The great cataract in the New River was in January eating its way backward, that is to say southward, at the rate of a mile in three days, with a width of some 1700 yards and a fall of 100 feet. The farms in the Imperial Valley are unable to avail themselves of the water so copiously



Upper figure.—Partial destruction of the town of Mexicala, Mexico, by the New River. *Lower figure.*—The New River cutting into the farm lands near Imperial, California, forming banks 70 feet in height, which are constantly falling in.

supplied, since it lies below their level; a great inland sea is arising and dispossessing the railroad and the people whom it serves; and the probability of the diversion of the whole Colorado River northward threatens to deprive of water the settlers in Arizona and Mexico from the Grand Cañon down to the Gulf of California. It needs the philosophic spirit of a Lyell to regard physiographic changes of such magnitude with admiration rather than dismay.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Lord Curzon was elected Chancellor of the University on Thursday, March 14. The votes recorded were:—Lord Curzon, 1101; Lord Rosebery, 440. There are 6576 members of Convocation, so that about one-quarter of them came to Oxford to vote. Lord Curzon was a commoner of Balliol, afterwards a fellow of All Souls, and he gained the Lothian and Arnold prizes. He received an hon. D.C.L. in 1904 on the occasion of the late Chancellor's installation.

The statute brought forward in Congregation on May 12 to provide an official residence for the Savilian professor of astronomy adjoining the observatory in the parks was lost by 55 votes to 156. In the course of the debate on the proposal, the Warden of All Souls', one of the Radcliffe trustees, stated that the trustees would welcome a scheme for the cooperation of the University and Radcliffe Observatories.

CAMBRIDGE.—A lecture will be given by Sir Frederick Ely on "The Practical Side of Famines in India" on Wednesday, April 24, at 5.30 p.m., in the museum of archæology. The lecture will be open to members of the University and others who are interested in the Indian Empire.

THE King of Spain has, *La Nature* reports, created a chair of automobilism at l'École des Arts et Sciences at Madrid. The professor will be expected to give all the practical and theoretical instruction young chauffeurs require.

A PARAGRAPH referring to the Indian Institute of Science appeared in the *Pioneer Mail* a few weeks ago, and was printed in an abridged form in these columns. Dr. Morris W. Travers, F.R.S., director of the institute, writes to say that he has had numerous applications for admission to the institute, so the statement in the *Pioneer Mail* that it will be difficult to obtain students is scarcely correct. As to the standard required for degrees in Indian universities, Dr. Travers remarks:—"It is true that I have expressed disappointment at the standard of the work required for degrees in the Indian universities, and am of the opinion that the practical teaching is quite inadequate. I have met only one research student, and have heard of one other."

A CONFERENCE on the teaching of hygiene and temperance in the universities and schools of the British Empire will be held in London on St. George's Day, April 23. The conference is convened by a committee formed to stimulate general interest in the scientific teaching of hygiene and temperance as an integral basis of national education, and to bring before the country during the visit of the Colonial Premiers information as to what is being done in various parts of the Empire. Among the members of the committee are Sir Lauder Brunton, Sir Thomas Barlow, Sir Victor Horsley, Mr. Mayo Robson, Dr. Claude Taylor, and Prof. Sims Woodhead. Further information and tickets of admission to the conference may be obtained from the honorary organising secretary, Miss St. John Wileman, 11 Chandos Street, Cavendish Square.

A RECENT article in the *Pioneer* of Allahabad deals with the work and usefulness of the Thomason Civil Engineering College at Roorkee, United Provinces, which is the leading engineering college in India. In 1891 the college was transferred from the Public Works Department to the Education Department, affiliated to Allahabad University, and its educational staff strengthened on the purely scientific side. The Government of the United Provinces has decided again to extend the college, and the improvements will call for an expenditure of three and a half lakhs. The important part which a properly organised technical institution may play in industrial development should be borne in mind when the extensions or changes at Roorkee are under consideration. Higher technical education is, of course, costly to provide, but the development of technical institutions on broad scientific lines is an urgent need in India, and in endeavouring to meet it the close relation between pure and applied science must be remembered. It is to be hoped that further developments at Roorkee will continue along the lines proved to be successful at home, and result in a strengthening of Thomason College and other Indian educational institutions.

THE council of King's College, London, with the assent of its court, has concluded an agreement by which the departments of the college dealing with arts, laws, science, engineering, and medicine (preliminary and intermediate studies) are to be incorporated in the University of London on terms similar to those recently adopted in the case of University College. An indispensable condition to the incorporation of the college is the raising of a sum of 125,000*l*. Of the sum in question 22,000*l*. is needed to pay off the debt on the college, 37,000*l*. to pay off the debt on King's College School, which will thereafter be placed under separate government, and 66,000*l*. to form an endowment fund and enable the college to occupy the whole of its premises. An appeal is being made to the public to provide this amount. The appeal has been endorsed by the Senate of the University of London, and already encouraging promises of support have been given. The Goldsmiths' Company and the Clothworkers' Company have each given 5000*l*. In addition to the 125,000*l*., the council asks for 20,000*l*. for the endowment of the theological department. Donations may be given generally to the fund in aid of the incorporation of King's College in the University of London, or else to any of the specific objects above mentioned. No sum will be devoted to the theological department unless specially given for that purpose.

THE eleventh annual distribution of prizes and certificates to the students of the day college and evening classes of the South-Western Polytechnic, Chelsea, took place on March 15. In the unavoidable absence of the Lord Chief Justice (Lord Alverstone), Sir Owen Roberts presented the awards. The principal, in the course of his report on the session 1905–6, spoke of the satisfactory character of the work carried on, and directed special attention to the large increase of student entries in the natural science department. He referred to the need which existed for more continuous work on the part of the students, and instanced the fact that during last session the average hours worked by each adult student in the day classes was only 234, or the equivalent of eight weeks' full work out of thirty-six weeks possible. The institute's record in respect of examination honours and degrees had been well maintained. The equipment of the various departments had been largely increased, and was being rapidly brought up to the standard of modern requirements. Sir Owen Roberts, in addressing the students, expressed satisfaction at the close relationship between the institute and London University. He urged the desirability in the case of persons actively engaged of some study to take them outside their ordinary occupation, and which was provided by the scheme of work carried out in the institute.

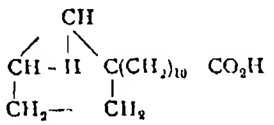
THE inaugural lecture of the new Sibthorpian professor in the University of Oxford develops a plea for the reconsideration of agriculture by the University. Although Dr. Somerville has been appointed professor of rural economy, his present duty is to lecture upon forest botany, and he makes it clear that this is not his own interpretation of the term "rural economy." Those who read this lecture will agree that a good case is made out for agriculture as a university subject. Dr. Somerville, as becomes a new professor, contents himself with making suggestions. Outsiders interested in the development of agriculture will probably wish that it had been possible to make demands, for it is surely time that Oxford was doing something for agriculture. The first page of this lecture tells us that Sibthorp endowed the chair in 1796; we read further that for a century it was the only university chair of its kind in England; but when, after following Dr. Somerville's account of the progress of agricultural education during this century, we pause and ask what Oxford's share has been, we find that it has been practically *nil*. Occasional lectures have been given, and once or twice attempts have been made to introduce an agricultural course, but the University has rejected the schemes of the advocates of agriculture, and now, 110

years after Sibthorp's foundation, Oxford's new professor is pointing out that while sixteen of the twenty-five university graduates recently appointed to the Indian Agricultural Department have been trained in Cambridge and Edinburgh, "Oxford has not supplied a single candidate for these Imperial posts." We should like to urge reconsideration of the subject on other grounds. Agriculture needs the support of the English universities, and in the past it has suffered through their neglect. By her influence on the young landowners who pass through her colleges Oxford might make her teaching felt on many an English estate.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, March 7.—Prof. R. Meldola, F.R.S., president, in the chair.—The constitution of chaulmoogric and hydnocarpic acids: M. **Barrowcliff** and F. B. **Power**. A study of the oxidation products of chaulmoogric acid leads to the conclusion that it exists in a state of tautomerism between 1-α-carboxy-n-dodecyl-Δ^4-*cyclo*pentene and 1-α-carboxy-n-dodecyl-1:4-*bicyclo*pentane. Hydnocarpic acid, $C_{16}H_{28}O_2$, is a homologue of chaulmoogric acid. Its constitution may accordingly be represented by the following formula:—



—Hydrolysis of amygdalin by acids: R. J. **Caldwell** and S. L. **Courtauld**. The authors have studied the action of acids in comparison with that of enzymes on this "bioside," and the results show that though amygdalin is ultimately resolved by acids into hydrogen cyanide, benzaldehyde, and two molecular proportions of glucose, the separation of the glucose is effected in two stages. By carefully hydrolysing amygdalin by means of a normal solution of hydrogen chloride at 60° the authors have prepared mandelonitrile glucoside.—Mandelonitrile glucosides. Prulaurasin: R. J. **Caldwell** and S. L. **Courtauld**. Fischer's glucoside bears the same relation to prulaurasin as amygdalin bears to the isoamygdalin described by Dakin, which is to be regarded as the derivative of inactive mandelonitrile, amygdalin and Fischer's glucoside being derived from *l*-mandelonitrile. Sambunigrin must be regarded as the β-glucoside of *d*-mandelonitrile.—The hydrolysis of amygdalin by emulsin: S. J. M. **Auld**. The hydrolysis of amygdalin by emulsin may proceed in three ways depending on the mode of attachment of the emulsin. The experiments so far carried out by the author indicate that benzaldehydecyanohydrin and the αβ-disaccharide are formed, and the latter then resolves into two molecules of dextrose.—Electrolytic reduction, part iii.: H. D. **Law**. The products of electrolytic reduction of the aromatic aldehydes in alkaline solution are compounds of the hydrobenzoin type, but this reaction is completely altered when a methyl group is substituted in the *ortho* or *meta* position of the benzene nucleus. Compounds of a resinous nature are obtained in the latter case.—New cerium salts: G. T. **Morgan** and E. **Cahen**. The aromatic sulphonates of this element are usually soluble crystalline compounds resembling the thorium sulphonates previously described by one of the authors.—Volume changes which accompany transformations in the system $Na_2S_2O_3 \cdot 5H_2O$: H. M. **Dawson** and C. G. **Jackson**. The changes which take place in the system $Na_2S_2O_3 \cdot 5H_2O$ when subjected to certain temperature variations, have been investigated by the dilatometric method.—Depression of the freezing point of aqueous solutions of hydrogen peroxide by potassium persulphate and other compounds: T. S. **Price**. Potassium persulphate causes a less molecular depression of the freezing point of aqueous solutions of hydrogen peroxide than it does of water, and the conclusion is drawn that an unstable compound is formed in solution.—The formation and reactions of imino-compounds, part iii.: the formation of 1:3-naphthylenediamine and its derivatives from o-toluonitrile: J. F. J. **Atkinson**, H. **Ingham**, and J. F. **Thorpe**.—The action of ethylene dibromide and of propylene dibromide on the disodium derivative of diacetylacetone: A. W. **Bain**.

Mathematical Society, March 14.—Sir W. D. Niven, vice-president, in the chair.—Mr. G. W. **Evans-Cross** exhibited his calculating machine, the myriometer. The instrument has several different forms, which are all, in principle, modifications of the slide-rule. In the form in which the instrument can be used for multiplication, the rule consists of a number, equal to that of the digits in one factor, of slips placed diagonally in a frame, and the slide carries as many cursors as there are digits in the other factor. The instrument will give exact results for numbers of six or eight digits. In other forms the instrument can be used for various calculations relating to commerce, such as the reduction of the interest on a stated sum from one percentage to another. In another form slides can be set so as to give the calendar of any year, B.C. or A.D., and all the new moons of the year.—Invariants of the general quadratic form modulo 2: Prof. L. E. **Dickson**. Complete sets of independent invariants, and also of linearly independent invariants, are obtained for quadratic forms of not more than five variables in the field of order two, and those invariants of quadratic forms of six variables which can be deduced are also given. It is shown that the complete classification of quadratic forms can be accomplished by means of invariant functions.—Linear partial differential equations of the first order: J. **Brill**. The paper is occupied with a general review of the theory, and an endeavour to ascertain the relations of exceptional solutions to the solutions of classified types.—The reduction of the factorisation of binary septans and octans to the solution of an indeterminate equation: Dr. F. **Stuart**.—An informal communication on the representation of functions by means of series of a special type was made by Prof. A. E. H. **Love**.

PARIS

Academy of Sciences, March 11.—M. Henri Becquerel in the chair.—Some details of the spectroheliograph: H. **Deslandres**. Remarks on a recent paper by M. Millochau in the *Comptes rendus*. Many of the details described by M. Millochau as new have been used by the author for years, and further details of working are now added.—A new contribution to the study of the stinging flies of intertropical Africa: A. **Laveran**. A detailed account of the various species found in the districts of Senegal, Mauritania, the Upper Senegal and Niger, French Guinea, the Congo Free State, and Mozambique.—The direct dehydration of dimethyl-isopropyl carbinol: Louis **Henry**. The dehydration of this alcohol might be expected to give rise to pure tetramethylethylene, and it was with this object in view that the experiments were carried out. The reaction proved to be not quite so simple, the fractionation of the hydrocarbons obtained by the action of acetic anhydride upon the alcohol giving tetramethylethylene and methyl-isopropylethylene, the former hydrocarbon being about three-quarters of the total product.—Some new results obtained in the detection and estimation of methane: Nestor **Gréhant**. An improvement of an apparatus previously described.—The perpetual secretary announced the death of François Joseph Herrgott, correspondant for the section of medicine and surgery.—A new comet: M. **Giacobini** (see p. 498).—The elastic deformations which leave invariable the lengths of a triple infinity of right lines: G. **Kœnigs**.—Waves of shock and combustion. The stability of the explosive wave: MM. **Crussard** and **Jouguet**. It is assumed that the combustion is incomplete in the wave, but is completed behind adiabatically and reversibly according to the law of dissociation, and the consequences of this assumption are worked out.—The conditions of formation of electrified centres of feeble mobility in gases: Maurice **de Broglie**. Experiments on carbon monoxide flames and flames containing hydrogen lead to the conclusion that the presence of centres of feeble mobility in the gases issuing from flames appears to be related to the production in the flame of solid or liquid products, or to the presence of some centres previously existing in the normal state in the atmo-

spheric air.—A contribution to the study of the latent photographic image: Eug. **Demole**. Some experiments on the reversal of the image caused by the presence of a feeble oxidising agent, such as potassium ferricyanide. The author puts forward a theory of the process based on the formation of a hypothetical silver hypobromite.—An exact method of separating ammonia and methylamine: Maurice **François**. The method is based on the fact that ammonia is readily absorbed by yellow oxide of mercury, whilst methylamine is not acted upon by this reagent.—The constitution of the azo derivatives of ethyl benzoylacetate: A. **Wahl**.—The β-chlorethyl and vinyl ketones: E. E. **Blaise** and M. **Maire**.—The influence of manganese salts on alcoholic fermentation: E. **Kayser** and H. **Marchand**. The effect of adding manganese salts to a fermentable liquid is to increase the amount of sugar fermented, the yields of alcohol, glycerine, and volatile acid all being greater.—A new glucoside, hydrolysable by emulsin, extracted from the seeds of a Strychnos from Madagascar: Em. **Bourquelot** and H. **Hérissey**. The name bakankosine is given to the new glucoside, and its method of preparation, properties and products of hydrolysis are given in detail.—The cytological peculiarities of the development of the mother cells of the pollen of *Nymphaea alba* and *Nuphar luteum*: W. **Lubimenko** and A. **Maige.**—The ecological characters of the vegetation in the eastern region of the Kabyle and Djurjura: G. **Lapie.** The forest vegetation in this region presents well-characterised zones standing clearly in relation with the climatological, topographical, and edaphical conditions.—A phenomenon of plant pseudomorphosis analogous to the pseudomorphosis of minerals: N. **Jacobesco.**—A spiky formation characteristic of the last dorsal vertebra in man: R. **Robinson.**—The tectonic north of Meurthe-et-Moselle: René **Nicklès** and Henri **Joly.**

CALCUTTA

Asiatic Society of Bengal, February 6.—The exact determination of the fastness of the more common indigenous dyes of Bengal and comparison with typical synthetic dyestuffs, part i., dyeing on cotton: E. R. **Watson**. The author gives a summary of the available evidence as to the fastness of the indigenous Bengal dyes, and points out that this evidence is wanting in precision and is in many cases self-contradictory. The author has prepared samples of cotton dyed with the more common Bengal dyes, so far as possible according to native methods, and has tested the fastness of these dyeings (1) to light, (2) to washing with soap, (3) to alkalis, (4) to dilute acids such as perspiration, testing at the same time by the same methods a representative collection of dyeings with synthetic materials. Tables are given in which the fastness of each dyeing under each condition is expressed quantitatively. The dyestuffs turmeric, safflower, *palas* (*Butea frondosa*), *latkan* (*Bixa Orellana*), red sandal (*Pterocarpus santalinus*), and *padauk* (*Pterocarpus dalbergioides*) are of very inferior fastness. *Manjista* (*Rubia cordifolia*), catechu (*Acacia catechu*) and *bakam* (*Caesalpinia Sappan*) compare favourably with the great majority of synthetic dyes.—*Breynia vredenburgi*, an undescribed echinoid from the Indian Ocean: Major A. R. S. **Anderson**. The genus Breynia was founded in 1847 by Desor for Spatangidæ characterised by the simultaneous presence of the three kinds of fascioles, internal, peripetalous and subanal. Only one living species had hitherto been described, *Breynia australasiae*, from the Pacific Ocean. Another species was discovered by Major Anderson at Port-Blair in the Andamans and has been named *Breynia vredenburgi*. The original specimen is now in the Indian Museum.—Note on the common raven (*Corvus corax*): Lieut.-Col. D. C. **Phillott.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 21

ROYAL INSTITUTION, at 3.—Biology and Progress: Dr. C. W. Saleeby.

CHEMICAL SOCIETY, at 8.30.—The Synthesis of Polypeptides: Emil Fischer.—Organic Derivatives of Silicon. Part iii., *dl*-Benzylmethylethylpropylsilicane and Experiments on the Resolution of its Sulphonic Derivative: F. S. Kipping.—On the Reduction of Carbon Dioxide to form Aldehyde in Aqueous Solutions: H. J. H. Fenton.—The Mechanism of the Rusting of Iron: G. T. Moody.—Some Compounds of Guanidine with Sugars, Part i.: R. S. Morrell and A. E. Bellars.

LINNEAN SOCIETY, at 8.—On the Origin of Angiosperms: E. A. Newell Arber and John Parkin.—*Exhibitions*: Water-colour Sketches of Alpine Flowers: Miss Helen Ward.—Photographs of Transvaal Trees and Tree Scenery: J. Burtt Davy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Rail Corrugation: J. A. Panton.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 9.—Rays of Positive Electricity: Prof. J. J. Thomson, F.R.S.

PHYSICAL SOCIETY, at 5.—Experimental Mathematics: Mr. Pochin.—Logarithmic Lazytongs and Lattice Works: Mr. Blakesley.—A Micromanometer: Mr. Roberts.—Electrical Conduction produced by heating Salts: Mr. Garrett.

INSTITUTION OF CIVIL ENGINEERS, at 8.—A Point in Turbo-Alternator Design: F. J. Kean.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Röntgen, Kathode, and Positive Rays: Prof. J. J. Thomson, F.R.S.

MONDAY, MARCH 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Photographic Report of a Journey through the Highlands of Duab (Zarafshan, &c.): W. Rickmer Rickmers.

INSTITUTE OF ACTUARIES, at 5.—On the Relation between the Theories of Compound Interest and Life Contingencies: J. M. Allen.

TUESDAY, MARCH 26.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Application of Hydro-Electric Power to Slate Mining: M. Kellow.—Electrically Driven Winding Gear and the Supply of Power to Mines: A. H. Preece.

WEDNESDAY, MARCH 27.

GEOLOGICAL SOCIETY, at 8.—On the Southern Origin attributed to the Northern Zone in the Savoy and Swiss Alps: Prof. T. G. Bonney, F.R.S.—The Coral Rocks of Barbados: J. B. Harrison, C.M.G.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

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THURSDAY, MARCH 28, 1907

ULTRAMICROSCOPES

Les Ultramicroscopes Les Objets ultramicroscopiques By MM A Cotton and H Mouton Pp 232 (Paris Masson et Cie, 1906)

THE magnitude of an object which can be rendered visible by the ordinary use of the microscope has a lower limit which is well understood and can be succinctly expressed It depends not merely upon the construction of the instrument, but also upon the character of the light employed and upon the liquid used for immersion The instrument should possess a large numerical aperture, which is again increased by immersion in the ratio represented by the index of the immersing liquid, the result being the scientific expression for the power of the instrument, with a given magnifying power, to resolve close lines or points As regards the light itself, the limit of resolution is proportional to the wave-length, so that shorter wave-length implies greater power of resolution When special light is not selected for employment, the mean value of the wave-length is 0 55 μ, where μ signifies 0 001 of a millimetre

Taking full advantage of these principles and of the high index, 1 66, of monobromonaphthalin as an immersion liquid, it may be said that the smallest visible objects have a magnitude not less than 0 17 μ Bodies smaller than this are called ultramicroscopic Some plan other than the usual microscope method must be adopted in order to make their existence appreciable, and it is upon this subject that MM Cotton and Mouton have written the very valuable and learned book before us In it will be found accounts, not merely of their own work, which is far-reaching and in practical points highly ingenious, but also of that of other investigators in the same field

There are two methods at present in existence, which may be called respectively that of ultra-violet light and that of diffraction in a dark field The first method aims at taking advantage of the short length of ultra-violet wave-lengths The sources of light are electric sparks formed between wires, which may be of magnesium, producing wave-lengths of 0 280 μ, or of cadmium, producing those of 0 275 μ, the former being more intense, the latter more homogeneous Such waves produce no effect upon the eye, though much upon fluorescent screens and photographic plates But they are readily absorbed by glass Hence the media (excepting air and immersing liquids) through which they pass on their way to the fluorescent screen or photographic plate, as the case may be, must be of quartz, and those above the stage of the microscope must, to avoid effects of double refraction, be of fused quartz Thus the whole apparatus is highly specialised On the other hand, the rays employed being homogeneous, there is no chromatic aberration to be considered in the design of the lenses.

The image formed by the objective is again magnified by the ocular, employed in such a way as to form a second real image at the place where finally is placed the fluorescent screen or photographic plate With such an apparatus the limit of magnitude of the objects detected would be reduced to 0 09 μ

The second and more recent method of detecting ultramicroscopic bodies is to employ their power of diffracting the light which falls upon them They thus become mere point sources of light, but diffraction discs are formed upon the retina of the eye, as in the case of stars the dimensions of which are far too small to subtend an appreciable angle, even with the most powerful telescopic aid

In the microscope, then, the illuminated ultramicroscopic object merely appears as a star of light The form of the object is entirely unobserved, its presence only being appreciable when certain conditions are fulfilled These are that the illumination shall be intense, that the field shall be profoundly dark, and that the objects themselves shall be sufficiently sparsely distributed in the field It is advantageous, too, to employ those rays which make as small an angle with the illuminating beam as is consistent with other conditions

To ensure the dark field it is strictly necessary that *none of the illuminating light shall*, except by diffraction, pass into the objective

First, we have described in detail the apparatus of Siedentopf and Zsigmondy In this the light from a narrow slit is focussed in such a way as to pass horizontally through the transparent medium under observation, forming a much diminished image of the slit exactly in the point of view of the microscope In this image the width of the tape of light producing it corresponds to the length of the slit, and the depth to the width of the slit The depth of the illuminated region thus becomes, with a knowledge of the diminishing power of the train of lenses strictly calculable, this being of importance in estimating the number of particles rendered visible in a cubic millimetre No part of the illuminating beam can, except when diffracted by small particles, pass into the objective The mean direction of the rays which do so pass will be at right angles to the illuminating beam The plan has the great advantage that an immersing liquid can be employed in the examination of solids, such as glasses tinted with metals, or of liquids beneath a covering glass The adjustments must, however, be extremely nice, and require that the whole apparatus should be mounted upon one bank

The authors have devised a simpler plan of illuminating the subsurface regions of a medium by taking care that incidence with the surface shall be at an angle exceeding the critical angle To this end a small but intense beam of light is brought from a small arc downwards at an angle of 51° to the vertical This passes at vertical incidence through the bevelled edge of a glass plate about 1 cm thick upon the microscope stage It is then totally reflected upwards by the lower surface towards the upper one

Upon this is placed the microscope slide, with an intervening drop of cedar-wood oil, so that total reflection does not occur again until the upper surface of the cover glass is reached, when the ray is again sent downwards and passes away through another bevelled edge. It will be understood that the preparation does not contain air. On this plan no immersion liquid can be employed in the usual place between the cover glass and the objective, but, on the other hand, the rays diffracted by small particles come off from the main beam at angles considerably smaller than a right angle.

Several chapters of the book are devoted to the investigations which have been or can be carried out by these ultramicroscopes, of high interest to many. As examples, we may cite the distribution of silver, gold, and other metal particles in the coloured glasses containing them, and in the hydrosols of such metals, the Brownian movements of ultramicroscopic bodies in colloids, and the translation of such bodies by electric current. Especially interesting is the description given of the motions of silver particles in the hydrosol of that metal prepared by the Bredig process of forming a submerged electric arc between silver wires. The particles, below certain dimensions, remain in stable suspension. They are quite ultramicroscopic, but still are capable of diffracting light. When an electric current is passed through the liquid contained in a layer, not too thin, between top and bottom planes of glass, quartz, mica, &c., the microscope being focussed at the middle of the layer, at a point about equally removed from either electrode, the points of light seen move equably in a direction from the kathode to the anode, the speed being proportional to the potential gradient. For one volt per centimetre the speed is about 3·78 μ per second. Above and below this central region, *i.e.* in beds adjoining the top and bottom boundaries, the motion is in the opposite direction, somewhat slower and less equable, and variable with the size of the particles.

If the boundary surfaces are of glass, these inverse beds are each about 25 μ in depth, and if the thickness of the whole layer is diminished until it is only 50 μ, it is these inverse beds which survive, the central one being gradually extinguished. The motion will then be entirely from anode to kathode.

The material of the boundaries affects the depth of the inverse beds, which with quartz is rather less than 25 μ, and seems to disappear with gypsum. Mica has much the same effect as glass in this particular.

The particles have such exceedingly small mass that their ultimate velocities in the central region are acquired instantaneously, and if the electrodes are connected with an alternating source of electromotive force, the points of light move backwards and forwards in harmony with the stress through a distance proportional to its mean value and to the period, the constant being sensibly consistent with the speed under uniform stress quoted above. If a three-phase machine is connected with three electrodes, the particles describe closed curves.

THOMAS H. BLAKESLEY.

ANCIENT AND MODERN SHIPS.

Ancient and Modern Ships. By Sir George C. V. Holmes, K.C.V.O. Part i., Wooden Sailing-ships. Pp. xv+168. Part ii., The Era of Steam, Iron, and Steel. Pp. xii+219. (London: Printed for His Majesty's Stationery Office by Wyman and Sons, 1906.) Two vols., cloth-bound, price 2s. 3d. each.

THESE volumes belong to the series of science handbooks issued by the authorities of the Victoria and Albert Museum at South Kensington. The author was for a long period secretary of the Institution of Naval Architects; he is well qualified for the task he has undertaken. Within extremely narrow limits of space (about 400 pages) he has produced a readable account of ancient and modern ships, in which a large amount of trustworthy information has been summarised and admirably illustrated. Although the original intention of these handbooks may have been the assistance and instruction of visitors to the collection of naval models in the museum, they will undoubtedly prove of interest as books of reference to all who are interested in the history of shipbuilding. Their moderate price ought to secure a large circulation.

In the first volume wooden sailing-ships are described. This part of the work was published in 1900, but has been revised and re-issued in company with the larger second part, in which the history of the era of steam, iron, and steel is traced, so far as mercantile ships are concerned. War-ships, considered as fighting machines, are not dealt with, but the influence of peculiarities in their construction upon the development of mercantile shipbuilding is illustrated. Formerly, the naval models at South Kensington included those of war-ships; when the Royal School of Naval Architecture was transferred to Greenwich (more than thirty years ago) the Admiralty also concentrated there its collection of war-ship models. South Kensington retained the mercantile models, and the present collection includes loans from private firms, as well as models which are national property. It is much to be desired that the collection should be made complete and should illustrate adequately the development of the British mercantile marine. If Sir George Holmes's handbooks should increase public interest in the collection and lead to its proper development, a good purpose will have been served. At all events, he has produced a work which will enable laymen to reach an intelligent understanding of the history of shipbuilding and the principles governing the structural arrangements of ships.

Beginning with an admirable account of ancient Egyptian vessels, the author describes boats still existing and to be seen in the Cairo Museum, although they were built nearly 5000 years ago. Ships of the Mediterranean and Red Seas—Phœnician, Greek, Roman, and Venetian—are next dealt with. Another chapter is devoted to the ancient ships of northern Europe, of which specimens have been discovered in Scandinavia in recent years.

Mediæval ships are briefly described and excellently illustrated, this section ending with an account of the famous *Sovereign of the Seas*, built about the middle of the seventeenth century A long chapter on modern wooden sailing-ships concludes this volume, and brings the history up to the construction of the great sailing three-deckers in the Royal Navy, which formed our most powerful war-ships until the middle of the nineteenth century On the mercantile side the gradual development of sailing-ships is traced, and the famous "clippers" are described

In the second volume steam navigation and the use of iron and steel for shipbuilding form the main topics. An interesting account is given of early wooden steamers It is worth note in passing that this year is the centenary of the completion of the *Clermont* by Robert Fulton, and her trials on the Hudson River The development of types of mercantile steamers is described, and numerous examples are included, amongst them being the *Great Eastern* and many vessels now employed on ocean or cross-channel service Tables of dimensions and particulars for Transatlantic steamers are given in an appendix On the structural side the book is valuable, it traces the influence of the use of iron and steel on dimensions and strengths of ships, and the differences between mercantile and Admiralty methods of construction A brief discussion of the external forces acting upon a ship at sea, and the resultant stresses on the structure, is given in one appendix, in another the puzzling subject of tonnage measurement is made as clear as it can be made to general readers This necessarily brief notice leaves many points unmentioned, the volumes should be read by all interested in the history of shipbuilding

W H W

FREQUENCY CURVES AND CORRELATION

Frequency-curves and Correlation By W Palin Elderton Pp xiii+172 (London Published for the Institute of Actuaries by C and E Layton, n d) Price 7s 6d

AS stated in a short preface by the president of the Institute of Actuaries, the object of this little volume is "to give a detailed description of the basis and practical application of those modern statistical methods that are associated with the name of Prof Karl Pearson" The work was undertaken, we understand, by Mr Elderton, at the invitation of the council of the institute, and we not only concur with the president in his commendation of the "public-spirited manner" in which Mr Elderton acceded to their request, but think that the action of the council of a professional society in thus endeavouring to place the results of recent research before the members in a convenient form for consideration is well worthy of note

In view of its purpose, the illustrations introduced are, of course, mainly of an actuarial character, but we have no hesitation in saying that the volume will be of great service to statisticians in other fields Much of Prof Pearson's work has been given in the Philosophical Transactions of the Royal Society, the *Philosophical Magazine*, and other publications which are not readily accessible to the ordinary statistician, and Mr Elderton's work will be most useful to the student by providing a short and handy summary of some of the more important results

After a brief introductory chapter, the author passes at once to the subject of frequency distributions, and the mean and standard deviation are defined (chapter ii) The method of moments is then treated in some detail, including the calculation of moments by the direct and the summation methods (iii) The deduction of Prof Pearson's curves from the hypergeometrical series is then given (iv), and their fitting by moments (v)

The subject of correlation is introduced in chapter vi , this is treated mainly from the standpoint of the normal distribution, but it is also shown that the formulæ may be regarded as obtained by the fitting of straight lines to the points in a "dot diagram," using the method of moments In chapter vii Prof Pearson's method of calculating the coefficient of correlation from any fourfold table, for measured or unmeasured characters, is described, and there follow two short chapters on probable errors (viii), and on Pearson's test for goodness of fit (ix) respectively The concluding chapter gives briefly the theory of the coefficient of contingency A few appendices deal with frequency curves other than Pearson's, with the integrals of the normal function and other matters

The exposition is careful and lucid, but some of the actuarial illustrations will prove rather a stumbling block to the non-actuarial reader Proofs are given which assume a fair mathematical knowledge, necessarily including the integral calculus, but the more lengthy and difficult proofs are omitted In some respects the work strikes one as a little limited in scope, but this arises naturally enough from the fact of its being addressed to a special public

There are only one or two points we have noted in reading that seem to call for mention In connection with the summation method of calculating moments, we would direct attention to the work of G F Lipps (Wundt's Phil Studien, xvii 538 *et seq* , 1901), and to the chapters on "die Summenmethode" in the Wahrscheinlichkeitsrechnung of Bruns (1906) Even if the *name* "method of least squares" be avoided, we would submit that this is no reason for omitting the short and simple proof that $\Sigma(x-by)^2$ is a minimum if $b=r\sigma_1/\sigma_2$ Without this proof the meaning of the coefficients of regression remains, in the general case, vague and indefinite In the chapter dealing with the coefficient of contingency, it might be as well to point out that the coefficient cannot attain the value unity unless the number of classes be indefinitely great, it cannot, in fact, exceed $\sqrt{(t-1)/t}$ for a $t\times t$-fold classification at the best

We cordially commend the volume to the attention of all students of statistics G U Y

CAVES AND WATERWAYS

La Spéléologie au XX^e Siècle By E A Martel Tome vi of *Spelunca* (Paris Société de Spéléologie, 1906)

THE completion of this volume deserves separate mention Its 800 pages contain a critical review by M Martel of practically all papers bearing on caves published in the last six years Since these papers, in their turn, refer to a large amount of earlier work, we have here a complete exposition of what is at present known of "spelæology" We pointed out, when noticing one of the separate parts, how the editor's comments render the abstracts readable and illuminating The papers have been classified, for the most part geographically, and the volume becomes practically an unconventional text-book of the lore of caves The range of subject permitted may here and there raise a smile, but it dies away in admiration of M Martel's energy Marcellin Boule, for instance, is cited on p 694 as describing a lava-flow in Auvergne intermediate in age between the epoch of the mammoth and that of the reindeer On p 727, again we read how a cave near Sévérac-le-Château —and memories of causse and cañon are recalled by the very name—was discovered in 1902 to contain a chapel, with accessories brought there during the persecution of the Catholic priests in 1793 A moment's reflection shows us that both references may prove of value Traces of man among French volcanic deposits need not be regarded as of Pliocene age The occurrence of religious emblems in caves may be due as much to a desire for secrecy as to the association of the cave itself with any form of ceremony It is thus hard to think of any worker in anthropology or natural history who would not gain information from M Martel's aid The alleged glacial deepening of Alpine valleys, and the formation of *cluses*, are discussed on p 526 Even writers on radio-activity may learn something from the notes on subterranean waters on pp 610–612 To most readers, the gradual growth of our knowledge regarding the incised drawings and paintings on the roofs and walls of caves (pp 654 705) will prove of surpassing interest M Martel presses home his contention that the bold representations of animals, sometimes amazingly faithful, are records or trophies of the chase

Three photographic illustrations are given of paintings in the cave of Altamira, near Santander, which Martel himself has visited Cartailhac (p 703) records how the discovery of these was made by a child, in the company of less observant scientific excavators Alcalde del Rio (p 704), in a paper published in 1906, mentions, in the cave of Hornos de la Peña, "a figure in a human attitude, but apparently an ape" M Martel adds that it has a tail, but why does he suggest, on p. 706, that M Piette's "être de caractère simiesque," engraved on a bone, is "probablement imaginaire"? Surely the Neolithic or even earlier artists, who saw so much that was wonderful and worth reproducing in the animal world around them, had hardly yet risen, or descended, to the consciously imaginary and grotesque?

M Piette has himself sent us a paper on "Fibules pléistocènes" (*Revue préhistorique*, 1906, p 1), in which he writes confidently as to his anthropoid from Mas-d'Azil He describes also a pendant ornament of incised reindeer-horn from Gourdan, on which a similar erect anthropoid, this time tailless, is clearly shown The figures which he publishes are of immense interest, and M Martel will doubtless note them in a future volume of *Spelunca* Though "spelæologists" cannot be allowed to found a science of their own, geologists, zoologists, anthropologists, and historians may well hope to link a friendly arm in theirs GRENVILLE A J COLE

OUR BOOK SHELF

Die chemische Energie der lebenden Zellen By Prof Oscar Loew Second edition Pp viii+133 (Stuttgart Fr Grub, 1906) Price 3 marks

THE great part played by the proteins in building up living cells has resulted in the ascription by physiologists to these substances of an indispensable *rôle* in vital processes If, however, protoplasm be regarded as a protein molecule, the difficulty at once arises how to account for the great differences in stability between the living and the dead protein This difficulty Pfluger, as well as Loew, attempts to get over by assuming a different constitution for the protein in the living body from that which is familiar to us in the dead protein as analysed in the laboratory Whereas, however, Pfluger ascribed the lability of the living protein to the presence of cyanogen groups which underwent transformation to amino-groups, Loew explains the difference by assuming the simultaneous presence in the plasma protein of aldehyde and amino groups, basing his hypothesis largely on the fact that the cells of certain vegetable organisms give a black reaction with dilute ammoniacal silver only so long as they are alive, the reaction failing when the cells have been killed by heat, acids, or alcohol

This blackening Loew and Bokorny assumed to be due to the presence of a reserve protein of special character, allied in the grouping of its constituent molecules to that which obtains in the living protoplasm

In the present book, the first edition of which appeared in 1898, the author examines the behaviour of living cells, the nature of their work, and the assimilation of food-stuffs in the light of his theory The great amount of work which has been carried out of late years by Kossel, Fischer, and their pupils on the constitution of the protein molecule, which has resulted in the separation of a large number of approximate principles, all distinguished by the possession of amino-groups, Loew dismisses with the airy suggestion that, during the action of the hydrolytic agents, acids or trypsin, a shifting of the intra-molecular groups has taken place, with the result that the amino-acids, &c, obtained at the end of the hydrolysis cannot be assumed to throw any light on the structure of the protein molecule itself Since in the plant organism it is probable that protein is formed from formaldehyde and ammonia by a process of polymerisation, the author imagines that the resulting product, in consequence of the presence of numerous aldehyde and amino-groups, must form a

molecule of extraordinary lability The first product of such polymerisation, which might be, as the author suggests, the aldehyde of aspartic acid, would further condense so as to form a body having the formula ascribed by Liberkuhn to the simplest protein This substance, "primitive peptone," by polymerisation of two molecules might form albumoses, and by the union of three molecules might form albumen

Although the facts brought together by the author are interesting, and although we must grant the possibility of aldehyde groups existing in some parts of the protein molecule, and perhaps being responsible for some of the chemical interactions which occur in the living cell, the new facts brought forward are too trivial effectively to modify our opinion on the structure of the protein molecule, which is based on the solid work of Fischer and his pupils

La Découverte de l'Anneau de Saturne par Huygens By Jean Mascart Pp 58 (Paris Gauthier-Villars, 1907) Price 2 francs

IN this small volume of 58 pages M Mascart tells the history of the discovery of Saturn's rings from the time of Galileo's dramatic anagram concerning the *altissimam planetam*, and his subsequent tragic disappointment and despair, to the time when, after many questionings and discussions Huygens finally established his accepted theory This history is most interesting, and includes a number of extracts from Huygens's corespondence on the subject, showing us how he had to fight for the acceptance of his theory and then had to fight again for the vindication of his priority in the matter The numerous reproductions of original drawings by Gassendi, Hélvétius, Riccioli, Huygens, Wallis, and others give an additional interest to the work, which is concluded by a lucid recapitulation of the later theories, such as that of Otto Struve, and discoveries concerning Saturn's unique appendage W E R

German Science Reader Part 1 Mathematics, Physics, and Chemistry Compiled by C R Dow Pp 85 (London J M Dent and Co, 1906) Price 2s

TWENTY pages of this book are devoted to mathematics, twenty-three to physics, nineteen to chemistry, and the remainder to a vocabulary of words not usually found in elementary class-books of German The mathematical portion is a synopsis of principles of mathematics with enunciations of problems, while the two remaining sections consist of definitions and descriptions of some physical and chemical properties of matter Any student of science who has an elementary knowledge of the German language should be able to read the book with the aid of the vocabulary, and the task would be more to his taste than reading or translating Grimm's or Andersen's fairy-tales No grammatical rules are given, as instruction in these is assumed to have been obtained in an earlier course

Céruse et Blanc de Zinc By M G Petit Pp 154 *Préparation mécanique des Minerais Résumé pratique* By F Rigaud (Paris Gauthier-Villars and Masson et Cie, n d)

BOTH these volumes are publications in the now well-known "Encyclopédie Scientifique des Aide-Mémoire" The first deals with the preparation and use in painting of white lead and zinc white respectively The second book provides a practical account of the various processes in use for the mechanical preparation of ores by separating them from their stony matrix

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE *No notice is taken of anonymous communications*]

The Ballot-Box.

IN reference to the weight judging competition, Mr Galton says that "the average competitor was probably as well fitted for making a just estimate of the dressed weight of the ox as an average voter is of judging the merits of most political issues on which he votes" These competitions are very popular in Cornwall, but I do not think that Mr Galton at all realises how large a percentage of the voters—the great majority, I should suspect—are butchers, farmers, or men otherwise occupied with cattle To these men the ability to estimate the meat-equivalent weight of a living animal is an essential part of their business, and, as an instance of their training I may mention that one of the butchers here has a son under thirteen years of age who is an adept at this work, and is already, I am told, one of the best weight judges in the district This boy has been trained to it by his father, and already surpasses his instructor Moreover, many of the competitors doubtlessly compete frequently, compare notes afterwards, and correct future estimates by past experience Now the point of all this is that, in so far as this state of things prevails we have to deal with, not a *vox populi*, but a *vox expertorum* I am afraid that the majority of such competitors know far more of their business, are far better trained, and are better fitted to form a judgment than are the majority of voters of any party and of either the uneducated or the so-called "educated" classes I heartily wish that the case were otherwise

F H PERRY COSTE

Polperro, Cornwall March 21

I INFERRED that many non-experts were among the competitors, (1) because they were too numerous (about 800) to be mostly experts, (2) because of the abnormally wide vagaries of judgment at either end of the scale, (3) because of the prevalence of a sporting instinct such as leads persons who know little about horses to bet on races But I have no facts whereby to test the truth of my inference It would be of service in future competitions if a line headed "Occupation" were inserted in the cards, after those for the address FRANCIS GALTON

MR HOOKER, in NATURE of March 21 seems not to have quite appreciated my principal contention in the letters "One Vote, One Value" and "Vox Populi" of February 28 and March 7 respectively It was to show that the verdict given by the ballot box *must be* the Median estimate, because every other estimate is condemned in advance by a majority of the voters *This being the case* I examined the votes in a particular instance according to the most appropriate method for dealing with medians, quartiles, &c I had no intention of trespassing into the technical and much-discussed question of the relative merits of the Median and of the several kinds of Mean, and beg to be excused from not doing so now except in two particulars First, that it may not be sufficiently realised that the suppression of any one value in a series can only make the difference of one half-place to the median whereas if the series be small it may make a great difference to the mean, consequently, I think my proposal that juries should openly adopt the median when estimating damages and councils when estimating money grants has independent merits of its own, besides being in strict accordance with the true theory of the ballot box Secondly, Mr Hooker's approximate calculation from my scanty list of figures, of what the mean would be of all the figures, proves to be singularly correct he makes it 1196 lb (which is the mean of the deviates at 5°, 15° 95°), whereas it should have been 1197 lb This shows well that a small *orderly* sample is as useful for calculating means as a very much larger *random* sample

and that the compactness of a table of centiles is no hindrance to their wider use I regret to be unable to learn the proportion of the competitors who were farmers butchers, or non-experts It would be well in future competitions to have a line on the cards for "occupation" Certainly many non-experts competed, like those clerks and others who have no expert knowledge of horses, but who bet on races, guided by newspapers, friends, and their own fancies

FRANCIS GALTON

Ketene

WHILE engaged in a research on the polymerisation of unsaturated compounds, we were led to try the action of a strongly heated platinum wire on various organic substances It is unnecessary at this stage to discuss our general results, and we will therefore deal at once with the action of the wire on acetic anhydride This substance when treated with the hot wire yielded a compound boiling about −65° and freezing about −130° which on standing at ordinary temperatures condensed fairly rapidly, yielding a brownish-yellow oil which, like the gas, has an extremely pungent smell We have not yet succeeded in obtaining the new body in a completely pure state, but as our work has been interrupted for some time, we venture to give the following preliminary data

On exploding one volume of the gas with excess of oxygen, there was a contraction of 1·01 volumes, and 1·85 volumes of carbon dioxide were formed while 1·86 volumes of oxygen had disappeared The corresponding numbers for the reaction $CH_2 CO+2O_2=2CO_2+H_2O$ are 1 1 2 2

Another sample gave a density of 39·9 ($H_2=2$), while that calculated for $CH_2 CO$ is 42 This sample was, however far from pure

The gas is absorbed by all the ordinary reagents, including water It combines with bromine, and appears to give a crystalline compound with bisulphites It chars when treated with phosphorus pentoxide or concentrated sulphuric acid These two reagents themselves produce traces of the gas when they are allowed to act on acetic anhydride We would add that we have also obtained the substance from acetone and it seems probable that it can be obtained by our method from all substances containing the group —CH_2—CO—

We would suggest that the body is the parent substance of Staudinger's ketenes We hope to be able to publish a fuller communication shortly

N T M WILSMORE
A W STEWART

University College London, March 25

Technical Terminology

THE writer on engineering terms in NATURE of March 21 (p 490) says that a single word is required to denote a central electric generating station

Perhaps *megadyne* would be acceptable, signifying "great power," and suggestive of the dynamo equipment of the station As a convenient abbreviation *mega* would readily enter into common use

J T RICHARDS

67 Thurleigh Road, Balham S W March 23

HIGHER EDUCATION IN THE UNITED STATES

THE most recent report issued from the United States Bureau of Education at Washington gives detailed information respecting recent developments of the various grades of education in the States down to June 30, 1904, and in it the Commissioner of Education gives a prominent place to the work of universities and colleges The statistics now provided make it possible to supplement the article published in these columns (vol lxviii, p 25) dealing with university education in the United States, and to give some indication of the progress which has been made in American institutions of higher education during recent years

There has been, in the first place, a large increase in the number of students attending universities and colleges in the United States. Whereas in the year 1899–1900 the total number of men students was, roughly, 61,800, and of women students 25,300, the numbers in 1903–4 had become, for men, nearly 72,000, and for women nearly 31,000.

The number of professors and instructors has increased in a similar manner In 1899–1900 the number of such teachers in institutions for men and for both sexes was 12,664 men and 1816 women, in 1903–4 these numbers had become 15,342 men and 2272 women In institutions for women alone the increase is not so decided The number of men teaching in these institutions was in the former year 697, and in 1903–4 only 631 The number of women, however, shows a marked increase from 1744 to 1834

It is interesting and instructive, too, to study the rise and fall in the popularity of the various subjects taken up by students At the two periods under comparison there were some remarkable differences In 1899–1900 the number of students studying classics and other subjects of general culture (as the report calls it) was roughly 57,000, but in 1903–4 the number had reached 65,000 In the earlier year the number of students in classes of pure or applied science was well on towards 26,000; in 1903–4 this number had increased to 32,000 The relative popularities of humanistic and practical studies may be said to have undergone little change at institutions of the rank under consideration But in this connection it must be remembered that at the great technological institutions, which are not included in these statistics, large numbers of men are engaged entirely in studying branches of applied science

The total value of property possessed by the institutions for higher education in the United States amounted in 1899–1900 to about 72,120,000*l*, and in 1903–4 this large sum had increased to 93,043,000*l* The endowment funds in the former year were valued at 33,240,000*l*, while in the latter year this provision for future contingencies had grown to 41,313,000*l*.

The value of gifts and bequests received by institutions for higher education during 1899–1900 was 2,399,000*l*, in 1903–4 the amount had increased to 2,740,000*l*, and last year as much as 5,000,000*l* was raised in this way Twenty-five institutions in the former year received from private donors gifts of as much as 20,000*l*, and in 1903–4 as many as twenty-nine institutions were equally fortunate

For the first of the years with which we are concerned in this comparison, the total income, excluding benefactions, amounted to 5,712,000*l*, of which about 2,234,000*l* was received in the form of tuition and other fees In 1903–4 the total income had reached 8,066,000*l* In connection with this sum, the Commissioner for Education remarks —"It is a well-known fact that the income derived from fees received from students forms only about one-third of the total income the remainder necessary to meet the expenses of the institutions being derived from endowment funds, State aid, and miscellaneous sources."

In 1903–4 the State and municipal aid to higher education amounted to 1,984,600*l*, as compared with 893,000*l* in 1899–1900

It is thus seen that the striking disparity between public and private efforts in behalf of higher education in the United States and Great Britain, pointed out in the article to which reference has already been made, has, in the interval of four years with which we are here dealing, become more accentuated, and, instead of having made up leeway, we appear to have fallen even further behind

The annual amount raised by private munificence for American universities and colleges has in a few years been doubled; and, as recent notes in these columns have shown, there is no sign of any decline in the generosity of the men of wealth in the States. The amount of money raised in this way in the United Kingdom during the period 1871–1901 was only one-eighth of that contributed in the United States in the same time; and if the present scale of American gifts be continued, the comparison at the end of 1931 will be such as to leave us at a still more hopeless disadvantage.

All the statistics here brought together tell the same story; alike as regards number of students, number of university teachers, total value of university property and total annual income, from whatever point of view looked at, there is evidence of a strong and healthy growth in the system of higher education in the United States, and, though it can by no means be suggested that similar work in this country has remained stagnant, the most optimistic student of British affairs will hardly maintain that our universities and colleges can show progress and development at all commensurate with that the report of the Commissioner of Education reveals as true of the United States. It is clear that patriotic men of science among us cannot afford to relax their efforts to increase the efficiency of our universities and colleges, and to supplement their number. Students of science do not need to be reminded of the intimate connection between cause and effect but it behoves them to take every opportunity to convince statesmen and the public that industrial supremacy is, in the long run, one of the effects of an adequately equipped and generously endowed system of higher education.

A. T. S.

THE ASIATIC SOCIETY OF BENGAL

THE Asiatic Society of Bengal, since its foundation in 1784 by that pioneer of oriental studies, Sir W. Jones, has played a leading part in the exploration of the natural history, philology, antiquities, and other branches of scientific inquiry connected with the East. Its Journal has been enriched by contributions from many eminent authorities, among whom may be named, in addition to its founder and older scholars such as H. H. Wilson, Prinsep, Sir A. Cunningham, Jerdon, Blyth, and Ball, men like Drs. Hoernle, Grierson and Annandale, Messrs. T. H. Holland and V. A. Smith, who are happily still at work. Like all scientific organisations in the East, it has suffered vicissitudes. The short and broken residence of Europeans in the country, pressure of official work, lack of native co-workers, want of libraries of reference, and last, not least, the indifference of the Indian Government, which prefers that its servants should devote their spare time to the judgments of the High Courts or the circulars of the Board of Revenue rather than to the science and literature of the country, have at times interrupted its progress. But under its present managers it seems to be inspired by a new spirit of enthusiasm. Its membership has increased within the last year by more than 50 per cent., the Indian Government has at last begun to regard it seriously, and through the Lieutenant-Governor of Bengal, who now acts as president, has suggested a scheme for bringing its work into closer relation with that of European officials.

These gratifying signs of progress are reflected in its new publications. Besides its well-known Journal, it has commenced the issue of a series of monographs prepared by competent writers, well illustrated and sold to the public at a very moderate price. These memoirs cover a wide range in the fields of natural science, philology, and anthropology. Among the most energetic naturalists is Dr. N. Annandale, the author of "Fasciculi Malayenses" and a study of primitive life in the Hebrides and Orkneys, who has now found a fresh field of activity as curator of the fine Calcutta collections. It is one of the ironies of fate that his name will survive in the scientific literature of the future linked with that of a new species of earwig, *Anisolabis annandalei*. He has recently contributed to the Journal a valuable series of papers on the fresh-water fauna of India, special monographs on Malaysian barnacles and the common Hydra of Bengal, and has opened an almost new field of study in his monograph on the "Fauna of a Desert Tract in South India," Rāmanād, in the Madura district, a region which might naturally, for zoological purposes, be regarded as worked out, but where his trained eye has discovered much new and interesting material.

In anthropology the society is judiciously working in connection with the Ethnographical Survey recently revived and extended by Lord Curzon, and has received from it several valuable communications. Mr. Sherring, who recently published an account of explorations in western Tibet, gives a further account of the Bhotiyas and Mr. A. H. Francke of the Dards of the same region, the late Father Dehon, S.J., describes the religion of the Uraons of Bengal, and Mr. E. H. C. Walsh discusses the remarkable cup-mark records in the Chumbi Valley. Here, again, Dr. Annandale has made a new departure in the first of a series of notes dealing with the arts, industries, and implements of the more primitive tribes, which describes the blow-gun, which seems to have been imported into southern India by the Malays. Studies such as these will, we trust, lead to the foundation of an Indian Pitt-Rivers museum, the ample materials for which at present in existence will soon disappear unless their collection is taken up in earnest.

In another direction the society has started a valuable work by establishing a medical section, which proposes to organise the workers now engaged in the study of tropical disease. In this connection the monograph by Messrs. Hooper and Mann on earth-eating, already described in NATURE (vol. lxxiv., p. 543, September 27, 1906) is full of interest. This remarkable craze appears to be spreading rapidly among the coolies in tea-gardens in Assam, and the dangers resulting from the practice are attracting serious attention. It is not a racial characteristic, but is found in all parts of the country; it appears to depend on the purely mechanical effect of various kinds of earth in relieving gastric or intestinal irritation. When once indulged in, the craving becomes uncontrollable, and leads to serious disease of the digestive canal.

All classes of students will accept these new publications as a record of excellent scientific work, and will congratulate this historic society on its recent satisfactory progress.

ROBERT WARINGTON, F.R.S.

WE regret to learn of the death of Mr. Robert Warington, F.R.S., at Harpenden on March 20. Mr. Warington was the son of Robert Warington, F.R.S., for a long time chemist for the Society of Apothecaries, and was born in 1838. Being of delicate health, he was educated entirely at home, and learnt his first chemistry from his father. In 1859 he worked for some time as a voluntary assistant in the Rothamsted Laboratory, and in 1862 went to the Royal Agricultural College at Cirencester as assist-

ant first to the late Dr Augustus Voelcker, and then to Prof A H Church In the next nine years Warington was chemist at Sir John Lawes's tartaric acid works, but in 1876, being desirous of devoting himself entirely to research, he came again to the Rothamsted Laboratory, where he remained until 1890

Although Warington's chief interest was in agricultural chemistry, he published a number of papers dealing with inorganic chemistry, and a detailed account of the various salts of tartaric and citric acids as they occur in their natural sources and in the manufacture of these substances

On his return to the Rothamsted Laboratory in 1876, Warington introduced several improved methods of analysis to save time or ensure greater accuracy in the routine determinations, there also he carried out the investigations on nitrification by which he made his name In 1877 appeared the paper of Schloesing and Muntz which showed that the production of nitrates in the soil must be due to living organisms, this work was repeated by Warington, who continued to investigate the conditions favourable to the process He showed that light would inhibit the change and that the drying of the soil was sufficient to destroy the organism, he also investigated the distribution of the organism, and showed that it was confined to the surface layers of ordinary soil, being only present in any quantity in the portion usually stirred by the plough Observing that the oxidation of the ammonia or urea employed sometimes stopped at the stage of nitrite, he succeeded in demonstrating that the process in ordinary soils takes place in two stages due to different organisms, one oxidising ammonia to nitrous acid, the other completing the oxidation to nitric acid Warington had actually accomplished the final step in the isolation of the two organisms, though he had not brought his work to the stage which satisfied himself, when his researches were unfortunately interrupted, and before he could resume Winogradsky published his elegant method of isolating the nitrous and nitric organisms by the use of a nutrient silica jelly

The circumstances which led to Warington thus missing the credit of the crowning point of his long researches on nitrification undoubtedly caused him bitter disappointment, he continued to live in Harpenden, but took no further part in research In the course of his investigations on nitrification Warington also observed and studied that other process of denitrification, by which previously formed nitrates are reduced again often with loss of the nitrogen as gas In later years this subject became very prominent for a time but the essential conditions of the action had been laid down before in Warington's papers He also investigated the method of estimating small quantities of nitrates by means of indigo and devised a standard process which, in a simplified form is now used by most water analysts

Warington gave a course of lectures in America for the Lawes Agricultural Trust in 1891, these were afterwards published by the United States Department of Agriculture, he was also Sibthorpian professor of rural economy at Oxford, 1894–7

His "Chemistry of the Farm" was published in 1881, and has since gone through fifteen editions, though only a small book, it is noteworthy for its lucidity and compactness in the handling of a mass of experimental data it is a model text-book which has no rival in any language, and on it the present generation of agricultural chemists in this country has been educated

Warington was elected to the Royal Society in 1886, his connection with the Chemical Society, of which his father was one of the founders, dates back to 1863, he was vice-president from 1889 to 1893, and in its Transactions appeared nearly all his original work

Warington's scientific work is distinguished by clearness and precision, the range is not wide, but everywhere it shows the minute care and the regard for accuracy with which he worked, in these respects his work only reflected his personal character.

A D. H

M P E BERTHELOT

THE death of M Berthelot was briefly recorded in the columns of NATURE last week The writer has been asked, as a former pupil of the great master, to give some account of his life and work

Marcelin Pierre Eugène Berthelot was born in Paris on October 25, 1827 He was the son of a medical man, Dr Jacques Martin Berthelot, and was educated at the Lycée Henri IV. In 1846 he obtained the prix d'honneur de philosophie at the concours-général, open to the best students of the highest classes of the lycées of Paris In February, 1851, he became assistant (préparateur) to Balard, the discoverer of bromine, who held the chair of chemistry at the Collège de France He kept this minor position until December 1859, when he was appointed professor of organic chemistry at the École supérieure de Pharmacie In 1865 a chair of organic chemistry was created for him at the Collège de France, which he held until his death In 1870–1 he acted as president of the Comité scientifique de défense during the siege of Paris In 1873 he was elected member of the Academy of Sciences, of which he afterwards became perpetual secretary In 1876 he was appointed inspector-general of higher education, in 1881, senator for life He was Minister of Public Instruction from December, 1886, to May, 1887, and Minister of Foreign Affairs in 1895–6 In 1900 he was elected a member of the French Academy

The French nation has from the time of the Revolution turned more than once to its scientific men for help in the conduct of national affairs The names of Lavoisier, of Lazare Carnot, mathematician and organiser of victory, of Fourcroy, of Dumas, and of Paul Bert recur to the memory But if Berthelot took an untiring part in public affairs, and especially, as member of the Conseil supérieur de l'Instruction publique, in educational affairs, it is not as an administrator or as a minister that he will be remembered, but as a chemist, and perhaps the greatest, as he was the most prolific, chemist of his age

Of his first studies in chemistry I have found no account, but we know that Claude Bernard in 1848 asked him for chemical assistance in his early work on glycogen

It was in 1850 that he published his first paper, on a method of liquefying gases Between that date and 1883 the Royal Society's catalogue records against his name the titles of between 600 and 700 papers, it is probable that their total number falls little, if anything short of a thousand, and to these must be added eighteen or twenty books, some of them, it is true, being only the summaries of published papers, but others, and especially his works on the history of chemistry, in a large measure independent publications To estimate justly the value and influence of this colossal contribution to science would be the work of months rather than of a few hours, and, indeed, the very mass of the work has perhaps hidden something of its significance and of the importance of the underlying ideas

Berthelot first gave his measure in his doctoral

thesis on glycerin and the fats, published in 1854. Chevreul had compared the fats to compound ethers, or esters, as we should now call them. Berthelot showed that the relation of glycerin to ordinary alcohol was comparable to that of phosphoric acid to nitric acid, thus introducing the important notion of polyatomic alcohols into chemistry. By a curious slip, inconsistent with the facts he had discovered, Berthelot compared the three series of glycerin esters to the orthophosphates, pyrophosphates, and metaphosphates, instead of to the neutral and "acid" salts of orthophosphoric acid. It was reserved to Wurtz, his great rival, to give the fullest interpretation and extension to his discovery.

The next question to which Berthelot devoted himself was a larger one. Gerhardt, who in the 'forties had contrasted the analyses of the chemist with the organic syntheses of nature, effected by the help of "vital force," already in 1853, in the introduction to his "Traité de Chimie organique," described as the object of chemistry:—"la connaissance des moyens de composer tous les corps, la connaissance des moyens de décomposition n'en étant que le préliminaire obligé." But at that time the only organic compounds that had been synthesised from their elements were urea, by Wöhler, and acetic acid by Kolbe. Berthelot set himself the great task of synthesising from their compounds the fundamental organic compounds, marsh-gas, formic acid, methyl and ethyl alcohol, acetylene, benzene—and succeeded. His work overthrew the 'vital force' theory as applied, not, indeed, to living matter, but to its non-living products. It forms the basis of those syntheses which have perhaps given to the chemistry of the nineteenth century its greatest prestige in the eyes of the world.

In his work on the fats, Berthelot had shown that they could be produced by the direct action of glycerin on the fatty acids, provided that time were given; it was characteristic of the man to generalise from this single discovery. In his work with his pupil, Péan de St. Gilles, on chemical affinity, published in 1862–3, he first introduced into chemistry the study of rates of reaction and of reversible reactions. Few single researches in the history of chemistry have been more fruitful of results.

He next set himself a task comparable to the work on organic synthesis. C. L. Berthollet in the early years of the nineteenth century had written a famous treatise on chemical statics; it was Berthelot's ambition to lay the foundation of chemical mechanics as a whole by a systematic study of the heat-changes involved in chemical reactions. Andrews, Hess, Favre and Silbermann, and others had carried out isolated investigations in this domain, but Berthelot, and almost simultaneously Thomsen, the Danish chemist, set out to investigate the whole field of thermochemistry systematically. In his "Mécanique Chimique fondée sur la Thermochimie," published in 1879, Berthelot gives the result of fifteen years' assiduous work. Full of brilliant discoveries of detail, of ingenious methods of experiment and calculation, the work cannot be said to have realised to the full the ambitions of its author. The "principle of maximum work," which he regarded as his greatest generalisation, is incomplete. But his work is, nevertheless, monumental in extent, and forms the necessary starting point for all fresh researches on the subject. In 1897 he published a vast collection of thermochemical data under the title "Thermochimie, Données et Lois numériques."

In one branch of thermochemistry, that of explosions, Berthelot's discoveries are as novel as they are fundamental. Working mainly with his pupil Vieille, he found that when an explosive mixture or compound is fired, the flame proceeds through the mixture at a gradually increasing rate until a maximum rate is attained, of which the value depends on the chemical composition of the explosive. This is the phenomenon of the "onde explosive," or explosion wave, especially familiar in this country through the remarkable work of Dixon, carried out subsequently. It was in the course of his work on explosive mixtures that Berthelot invented the well known calorimetric bomb, an extremely simple and accurate instrument for determining the heats of combustion of organic compounds.

The problems of vegetable chemistry began to interest Berthelot in 1876, when he showed that nitrogen could be made to combine directly with carbohydrates under the influence of the silent electric discharge. Later he found that the microbes of the soil played an important part in the fixation of nitrogen in the vegetable tissues—a discovery to which the work of Hellriegel and Wilfarth on leguminous plants gave the most brilliant confirmation.

In 1884 a fine laboratory was built for him on the heights of Meudon, and here, with the devoted and able collaboration of M. G. André, he carried out the vast series of researches on vegetable chemistry recorded in the four volumes on "La Chimie végétale et agricole," published in 1899.

Berthelot's work in the history of chemistry is on the same kind of scale as his experimental work. In a first book, "Les Origines de l'Alchimie," he traces alchemy to its origin in a combination of the ideas of Egyptian metal-workers (who from the practice of making alloys naturally desired to economise the use of the precious metals in their production) and of the Greek ideas of the transmutation of elements current in the school of Alexandria. In 1887–8 he published a more comprehensive work, in collaboration with C. E. Ruelle, the "Collection des Alchimistes grecs." This was followed in 1893 by a similar work, "La Chimie au Moyen-âge," which deals with the Syriac and Arabic alchemists translated by MM. Rubens Duval and Houdas. The author showed that the Latin works previously attributed to Geber (or Djaber, as he should be called) were late forgeries, and published authentic texts of the famous alchemist. These he supplemented in his last work, "Archéologie et Histoire des Sciences" (published in 1906), by printing the Latin translation of another work of Geber, the "Liber de Septuaginta," of which the Arabic original has been lost, together with a number of fresh memoirs on mediæval chemistry and on the composition of metallic specimens of Egyptian, Chaldaic, Persian, and Roman origin. On the more modern history of chemistry he published a book on Lavoisier, "La Révolution chimique" (1890), containing extracts from Lavoisier's note-books, and "La Synthèse chimique" (1875).

Besides these works and practical treatises on calorimetry and gas analysis, he published a number of volumes of essays—"Science et Philosophie" (1886), "Science et Morale" (1897), "Science et Éducation" (1901), "Science et Libre-Pensée" (second edition, 1905), and the correspondence with Ernest Renan, who in his "Souvenirs d'Enfance" has left so interesting an account of the beginnings of the life long friendship of the two men, was issued in 1898.

The "Cinquantenaire scientifique de M. Berthelot" gives an account of the jubilee celebration held at the Sorbonne on November 24, 1901, when, in the presence of the President of the French Republic and the great officials of State and of the learned bodies of France, M. Berthelot received the congratulations of the academies of the world. "Dès que vous abordez une question," said Moissan in addressing him on

behalf of the French Academy of Sciences, "vous l'étendez en la généralisant" But few men have united with the power to generalise such marvellous quickness and tenacity in working out detail That quickness and tenacity may be estimated by the volume of his work In his later life he had, of course, much help, but in his earlier years, when he often passed the night in the laboratory, he worked single-handed Berthelot rejected until well into the 'nineties (as Bunsen did until his death) the use of the atomic notation, chiefly perhaps from a horror of the enthusiastic and somewhat uncritical faith of contemporaneous exponents of the atomic theory

In person Berthelot was short and slight, and with the stoop of the student In lecturing he spoke rapidly and in a low voice, with no attempt at oratorical effect But his fine, regular features and brilliant blue eyes left an impression not easily to be forgotten Reserved and almost cold in manner, he cared for two things supremely, his work and his family He survived the shock of his wife's death, which took place on March 18, only by a few minutes

The French Parliament voted a public funeral, it took place on Monday in the Panthéon, where the remains of his wife rest beside his own

M Berthelot left a daughter and four sons, of whom one, M Daniel Berthelot, is well known for his researches in physical chemistry, and occupies a chair at the Ecole supérieure de pharmacie

P J HARTOG

NOTES

MEN of science in this country will probably have to wait a long time before they will see the Government and the nation pay such a tribute to the greatness of one of their number as was witnessed in Paris on Monday, when the national funeral of M and Mme Berthelot took place at the Panthéon Here politicians and people have little sympathy with intellectual greatness, and if M Berthelot had lived in Great Britain instead of France his death would have been mourned by the world of science but the Government would certainly not have hastened to secure for him the honour of a national funeral because our statesmen do not know the influence of scientific work on national character and progress, and to them men of science live in a world far beyond the range of practical politics where virtue finds its own reward To understand the right spirit of appreciation of a great man of science we have to cross the Channel and be present at a funeral like that of M and Mme Berthelot, for on such an occasion the French manifest incomparable qualities of organisation and tact From the report of the Paris correspondent of the *Times* we learn that not since the funeral of Ernest Renan have the population of the capital been invited to join the authorities in such a solemn demonstration of mourning for one of their great compatriots Amid impressive surroundings all that is representative of the dignity of the State was assembled from the President of the Republic to the members of the several academies, the council of the Legion of Honour, the Ministers, the members of Parliament and a host of the most eminent personalities of France After a portion of Beethoven's Symphony in C minor had been rendered, the Minister of Education, M Briand, ascended a small platform erected near the academicians and read a funeral oration in which he worthily honoured the illustrious dead Berthelot's attitude towards the religious sentiment he accurately summarised in the terms of a formula borrowed from Renan—"The real way of adoring God is to know and love what exists" Respecting Berthelot as a *savant*, he dwelt particularly on his *rôle* as a creator, the forerunner of more startling syntheses still The great moral quality of the man, the natural consequence of his philosophical ideas, was tolerance After the oration, the two coffins were carried to the peristyle of the Panthéon, where a monumental catafalque had been raised A splendid military pageant followed, the troops defiling past the coffins to the strains of the "Chant du Départ" and "Les Girondins," while flags were lowered and swords raised in salutation of the dead In the afternoon the public was allowed to visit the Panthéon, and in the evening the bodies were taken to the Panthéon vaults, where they occupy provisionally a place next to the remains of Victor Hugo

SCIENTIFIC men will do well to watch the course of events connected with the subject of Mr Haffkine's prophylactic and the Mulkowal accident, referred to by Prof Ross in last week's NATURE, as it is important that laboratories engaged in making prophylactics and sera shall not be lightly discredited on inadequate evidence—important not only for the laboratories but for the public, which in its alarm is led to reject these valuable agents In the House of Commons on March 20 Mr Morley gave a cautious written reply to a question by Sir W Collins on the subject He stated that Mr Haffkine is still in the employment of the Government of India, and has been offered "employment in that country on research work at a salary equal to that of which he was in receipt when he left India" But it is understood that Mr Haffkine is holding out not for the loaves and fishes of office, but for the vindication of himself, his laboratory, and his science from what appears to have been at least a very doubtful verdict Mr Morley also stated, somewhat too cautiously that "Dr Haffkine's prophylactic continues to be one of the precautions which are recommended by Government to the general populations against outbreaks of plague" But this is quite an inadequate description of it Mr Morley appears to have overlooked the facts that in official statements other measures such as segregation, disinfection, and evacuation, have been declared to be unavailing, that in the epidemic now raging in the United Province of Agra and Oudh, the Government of the province reported only last month (*Bombay Gazette*, February 18) to the effect that the prophylactic was the only measure affording real and substantial protection, and that in the Punjab alone up to October 1903, 1 327,075 people had been inoculated, with a declared reduction of mortality to about one-twelfth that occurring in the uninoculated (report on plague and inoculation in the Punjab by the chief plague medical officer, Lahore, 1904) But Mr Morley may be trusted to see that justice (and, let us hope, something more) is done in this case

LORD KELVIN, O M, has been nominated as president-elect of the Institution of Electrical Engineers for the session 1907–8, his term of office as president to begin next November Prof J J Thomson has been elected an honorary member of the institution

LORD AVEBURY will preside at the annual soirée of the Selborne Society, which will be held at the Civil Service Commission (Old London University), Burlington Gardens, on Friday, April 26 Illustrated addresses will be given, and there will be a display of microscopes and objects of interest

A *Times* correspondent at Kingston, Jamaica, reports that earthquake shocks are recurring with alarming frequency, the latest being at 1 30 a.m on March 25 All

the shocks have been sharp, though short, and accompanied by loud subterranean rumblings.

THE *Pall Mall Gazette* states that Mr Franz Herger, director of the Meteorological Observatory of the St Gothard, was caught by a snowstorm while returning from the observation tower, and his dead body was found a few days ago, almost completely covered with snow, near the Lucendro Bridge

THE seventy-ninth meeting of the German Association of Naturalists and Physicians will be held at Dresden on September 15–21 General meetings will be held on Monday, September 16, and Friday, September 20 at which lectures will be given by Profs Hempel (Dresden), Hergesell (Strassburg), Hoche (Freiburg-im-Baden), and Strassen (Leipzig) The sections will meet on September 16, 17, and 18 There will be a section of geophysics, meteorology and terrestrial magnetism, and anyone desiring to give a short lecture or demonstration to the section should communicate before May 25 with Prof Paul Schreiber, Direktor des K Met Instituts, Dresden-N 6 grösse Meissner Strasse 15

WE regret to see the announcement that Prof E von Bergmann, professor of surgery in the University of Berlin since 1882, died at Wiesbaden on Monday, March 25 in his seventy-first year For a few years before his appointment to his Berlin chair and to the directorship of the University Clinical Hospital he was professor of surgery at Würzburg An obituary notice in the *Times* records that in Berlin von Bergmann devoted himself to the development of Lord Lister's antiseptic methods and became one of the leading exponents of the purely aseptic treatment which dispensed with the carbolic spray, and relied upon the prevention of infection by means of perfect cleanliness His success was especially remarkable in operations upon the skull and the brain, and surgery owes to him considerable advances in this particular department of its labours After the death of Prof Virchow, von Bergmann became the most eminent representative of the German medical world, and he was a present or a past president of the leading medical and chirurgical societies Last year he was made a life member of the Upper House of the Prussian Diet German and foreign universities honoured him by the bestowal of their academic degrees, and only last December he celebrated his seventieth birthday, and received tributes of admiration and esteem from the leading members of his profession at home and abroad.

THE motion for the second reading of the Weights and Measures (Metric System) Bill was defeated in the House of Commons on March 23 by a majority of 32, 118 voting for the second reading and 150 against The Bill proposed that from April 1 1910 or at a later date to be fixed by Order in Council, the standard metre and kilogram should be established and that sales and contracts should thenceforth be made according to the metric system Mr Strauss, in moving the second reading, said that resolutions in favour of the Bill have been passed by the London County Council, large numbers of chambers of commerce, and many local authorities, and it is supported by the heads of many trade and engineering firms and numbers of trade unions He asked the House to give the Bill a second reading for three reasons —the loss of time and money in business and trade involved in the present system, the most serious waste of time in the education of children; and the loss of commerce with other countries owing to our dealing in weights and measures which to them are incomprehensible The incongruities and absurdities of the cumbersome British units of weights and measures were exhibited by Mr Strauss and Sir H Norman, who seconded the motion while the latter gave a convincing exposition of the simplicity and interdependence of the metric weights and measures

THE opposition made out a strong case against the Metric System Bill referred to above Mr Haworth urged that 80 per cent to 90 per cent of the engineers of this country are against the Bill, and that it had been estimated that in engineering alone the cost of the change would be 100 million pounds In shipping, measurements of draught, displacement, and tonnage, which are nearly universal on the British standard, would have to be altered throughout the world The cotton trade, again is carried on all over the world on the English measure Similar cases were quoted by subsequent speakers and it was also maintained that the greater part of our trade is with non-metric countries, and that unless the colonies and the United States adopted the change with us few of the advantages offered by the metric system could be reaped The metric system was legalised in Great Britain several years ago and the manufacturers of the country can adopt it when they find it to their interest to do so In commerce as in science it is desirable to secure international standards so far as possible, and the metric system has been adopted by many countries, and has become the basis of scientific measurements, because it provides simple and satisfactory standards An international system of weights and measures may be as impracticable as an international language but the advantages of either of these common means of expression are obvious When traders and manufacturers find that the metric system must be adopted in order to have commercial relations with other countries they will no doubt adapt themselves to the new circumstances Until some common agreement has been arrived at among leading business men, it can scarcely be urged that Parliament should make compulsory a system which would involve an industrial revolution

THE anniversary dinner of the Chemical Society was held on March 22 Prof Meldola, president of the society being in the chair Lord Rayleigh proposed the toast of ' The Chemical Society and he is reported to have said in the course of his remarks that an ardent student, if he is so disposed can become the parent of a new substance Others of maturer age look upon this increase of the chemical population as rather an embarrassment No doubt there is a multitude of details, and one can only hope that in the course of time generalisation may arise and be established which will supersede much of that detail, link it together and so render it no longer so serious a burden upon the memory In replying to the toast Prof Meldola said in its intimate relations with other branches of science chemistry is as far-reaching is cosmopolitan has as many points of contact with all branches of science organic or inorganic as any branch of science that is being cultivated at the present time He expressed regret at the enormous wastage of chemical talent and faculty going on all over this country, and said the society could do very much if it had larger resources to fall back upon The research fund should be in such a position that the society could afford to give personal grants to workers to enable them to secure the services of competent men to cooperate with them in their work. The toast of ' Scientific Societies ' was proposed by Sir

William Ramsay, and responded to by Lord Kelvin and Prof Ray Lankester Prof Lankester agrees that there is a need for great endowments for furthering chemical science and, indeed, the various departments of the whole scientific field, and that if learned societies make it known that they will administer those funds, the money will be forthcoming He considers it would be better to give money in this way than that it should be given, say, to universities, which Prof Lankester is unable to regard as promoters of scientific knowledge in this country Sir A Rucker however, in responding to a later toast, said that he has cherished as part of his creed that the business of a university is not only to teach, but to add to knowledge The Foreign Office and the Royal Society asked the University of London to undertake the establishment of a chair of protozoology, and it was done As Prof Lankester acted as the adviser of the Royal Society in this matter Sir Arthur Rücker thought the action was proof enough that he really believed in research by a university

In an article on the evolution of the horse family published in the March number of the *American Journal of Science* Mr R S Lull gives a series of diagrams illustrating the differences in relative size and form of the various generic types When referring to the suggestion that the one-toed Siwalik hipparion may be the ancestor of the zebras, the author is oblivious of the view that the latter form a mixed group one of the members of which is closely allied to the wild ass A paper by Mr C W Gilmore on a new species of the ichthyosaurian genus Baptanodon from Wyoming is also included in the same issue

The fifth annual report of the Philippine Bureau of Science (published at Manila in 1906) shows that the society did excellent work during the twelvemonth under review although its efforts were considerably hampered for lack of sufficient accommodation Special attention was directed to the prevention of cholera by means of cholera vaccine Although eradication of the disease seems impracticable it appears to be a fact that the vaccine confers a blood-immunity greater than that resulting in the case of typhoid by the use of typhoid vaccine, and it is considered that vaccination will prove of even greater value in the case of cholera than it is in that of typhoid

A model of the restored skeleton of the horned dinosaur *Triceratops prorsus*, duplicated from one in the U S National Museum at Washington has just been set up in the reptile gallery in the Natural History Museum The original bones upon which the restoration is based were obtained from the Laramie beds (Upper Cretaceous) of Converse County, Wyoming Another addition to the collection of very considerable interest is a specimen of the slughi (or gazelle-hound) of the eastern deserts, the gift of the Hon Florence Amherst The special interest attaching to these dogs (also known as Syrian or Persian greyhounds) is that they belong to the same type as one represented in the tombs of Beni Hasan, and are thus the oldest breed in existence The best strains are in the possession of the Bedouin chiefs, from one of whom the specimen presented by Miss Amherst was obtained

Considerable interest attaches to the exhibition in the entrance hall of the Natural History Museum of a specimen of the tile-fish, *Lopholatilus chamaeleonticeps*, a species remarkable, not only for its brilliant coloration—perhaps unequalled by any other non-tropical fish—but for its curious history The species first made its appearance off No Man's Land, Massachusetts, in 1879, when a specimen was taken in deep water on a cod-line. Soon after it could be taken in abundance with the same kind of apparatus, a catch of some 250 lb of fish (ranging individually from 10 lb to 40 lb) in the course of a couple of hours or less being not uncommon This raised the hopes of fishermen, and in the U S Fishing Report for 1881 it was stated that "there is every reason to believe that the tile-fish will rank among the most important food-fishes of the United States" About the time (1882) that New English fishermen were getting into the swing of the fishing the tile-fish, owing to ice in the Atlantic, disappeared as suddenly as it came, and it is only during the last fifteen years that it has re-visited the American Atlantic coast, where it can now be taken at a depth of about seventy fathoms

The commission appointed for the investigation of Mediterranean fever has issued part v of its report Staff-Surgeon I A Shaw, R N, shows by experiments on monkeys that infection is possible through the eyes, nose and digestive tract by means of infected dust and food and through scratches and wounds by the urine of patients The possibility of infection by unlimited contact is also demonstrated The same investigator shows that the *M melitensis* produces little toxin, and he has failed to obtain a curative serum of much potency, and experiments by Dr Eyre confirm the latter A preventive vaccine was prepared which seemed to possess considerable immunising powers Major Horrocks R A M C discusses the occurrence of Mediterranean fever in Gibraltar, and shows that its incidence there, as in Malta, is probably largely dependent on goats Dr Eyre contributes a bibliography of the disease from 1897 to 1907

Among the botanical papers included in the Proceedings of the Indiana Academy of Science 1905, Mr W J Young communicates an account of the embryology of *Melilotus alba*, stating that the megaspore mother-cell forms the embryo sac without undergoing division, and that a portion of the endosperm functions as a haustorium Mr G W Wilson enumerates the rust fungi with host plants recorded from Hamilton and Marion counties species of Dicæoma attacking cereals, and *Gymnoconia interstitialis* infesting the blackberry bushes, were the most injurious A description of the Leesburg Swamp and the plant associations occurring there is furnished by Mr W Scott

An account of experiments to determine the effect of stimulating organisms with different light rays is communicated by Prof L Hertel to *Naturwissenschaftliche Wochenschrift* (February 10) Two contingencies have to be taken into account, first, allowance must be made for the disparity in the intensity of the rays, and, secondly, the effect of stimulation will vary with the absorbent capacity of the organism for rays of varying wave-length When a method was applied for equalising the intensity of the different rays, the physiological effect was found to decrease from the red to the blue rays, but since the absorption of the rays by living tissue also varied in the same way the conclusion is evolved that the effect of light does not vary with the wave-length

A second paper on *Termes gestroi*, the white ant that is becoming a pest of considerable importance to the Hevea rubber trees in Tenasserim, is contributed by Mr E P Stebbing to the *Indian Forester* (January) The curious accumulations of rubber in the nests have given rise to some discussion The explanation put forward by the

discoverer, that the termites are concerned with these accumulations, has not received acceptance, and it has been suggested that they are due to natural exudation. Meantime, analysis has shown that the rubber is purer than the best ordinary latex, and thus the matter stands. On the subject of fire in teak forests, Mr. H. Rodger presents a note accompanied by illustrations representing probable stages in the destruction of the teak trees.

THE fifth supplement to the first volume of the *Philippine Journal of Science* is appropriated to an enumeration of the Philippine grasses. The author has revised the lists of Blanco, F. Villar, and other previous compilers to exclude doubtful species; he has also drawn up short keys for the identification of tribes, genera, and species. With regard to geographical distribution, one-fifth of the species is endemic, including the monotypic genus *Garnotiella philippinensis*; there is a pronounced affinity with the grasses of the Malayan and Indo-Malayan regions, and a fair sprinkling of Australian types. The determination of the bamboos is uncertain, but the author records a new species of Gigantochloa.

DISCUSSING the mechanical development of the German iron industry in a copiously illustrated article in the *Engineering Magazine* (vol. xxxii., No. 6), Mr. J. H. Cuntz shows that the three important factors which now make for economy are by-product coking, the utilisation of furnace gases in the gas engine, and advanced practice in electric driving of winding and rolling-mill engines.

THE bridge at the Victoria Falls of the River Zambezi was described in detail by Mr. G. A. Hobson in a paper read before the Institution of Civil Engineers on March 19. Several types of bridges were considered, but the nature of the situation made it obvious that a two-hinged spandrel braced arch was the one that most completely answered the requirements of the case. The bridge consists of three spans. The end span, on the left bank, is 62½ feet, and the other 87½ feet, while the central span is 500 feet between the centres of the bearings, with a rise of 90 feet. The entire bridge, with the exception of the main bearings, weighs 1500 tons. The engineering interest which attaches to the execution of this work is due in a large measure to the remoteness of the site. The question of erection was considered of primary importance, and every detail was devised to simplify the procedure.

THE admirable work that is being done by the corps of mining engineers in investigating the mineral resources of Peru is clearly shown in the numbers of the *Boletin* of that body recently received. In No. 41 Mr. M. A. Denegri gives a report on the mineral production of Peru in 1905. The production included 75,338 tons of coal, 49,700 tons of petroleum, and considerable quantities of gold, silver, copper, lead, bismuth, nickel, mercury, salt, and borates. Excellently reproduced photographs accompanying the report indicate that in many cases the mines are well equipped. In No. 44 Mr. Carlos E. Velarde describes the mineral district of Huancavelica. The copper and silver veins are of considerable importance, and the Santo Domingo colliery furnishes an ample supply of coal for steam raising, whilst coke for smelting purposes can be abundantly obtained from the coal of the Oyon collieries, thirty miles distant from Huancavelica. In No. 45 Mr. G. I. Adams deals at length with the water supply of the provinces of Arequipa, Moquegua, and Tacna. Lastly, in No. 46 Mr. F. M. Santolalla describes the mineral resources of the province of Santiago de Chuco. The district is one of the richest in Peru, and its mining industry has a great future in store when better means of transport are provided by the projected extension of the railway from Menocucho to Salpo. The deposits existing in the province may be divided into the metalliferous veins in eruptive rocks, veins in sedimentary rocks, and the coal seams of Callacuyan, Chasamuday, Ilaray, Hospital, and Angasmarca, all of which form part of the same coalfield.

THE admirable paper on petrol motor-omnibuses, read by Mr. W. Worby Beaumont before the Institution of Mechanical Engineers on March 15, forms a valuable contribution to the history of engineering, for there are few examples of rapid growth from the experimental stage to that of widespread practical importance so remarkable as that of the motor omnibus. There is no example so instructive in possibilities as the adaptation of the high-speed, high-power, light-weight petrol prime-mover to the heavy work of the operation of the motor omnibus on common roads. Barely four years have passed since the first petrol-propelled motor-omnibus may be said to have been regularly worked in public service in England, and within the last two years the number in London has increased from a few small vehicles to 795 in actual commission. These are carrying about 185 million passengers per year, and run from 90 to 120 miles per day, or 30,000 to 40,000 miles a year. There is great similarity in external design, but in the details of the mechanism and in the arrangement of the underframes there are considerable differences, which are clearly described by Mr. Beaumont and elucidated by the numerous excellent drawings to scale accompanying his paper. No standardisation in motor-omnibus construction can be expected for some time. The extraordinary mileage has accumulated much experience in a short time, but it has been very costly, and it must be admitted that, even with the finest material ever placed in the hands of the engineer, larger dimensions and greater surfaces are required to contend with the severe work of the present double-deck omnibus. Improvement may be looked for in the introduction of twenty-six passenger in place of the present thirty-four passenger vehicles. Then the weight of an omnibus may be materially reduced, and fuel and oil consumption and wear and tear also reduced, which, with a general observance of the legal speed-limit, will together add to the life and commercial efficiency of an omnibus. It is interesting to note that the cost of working a petrol motor-omnibus running 100 miles per day for 280 days per year may now be put as 9.56*d.* per mile, including depreciation at 20 per cent., while the average receipts per motor-omnibus mile in London exceed 13*d.*

WE have received from Washington a copy of the annual report of the Board of Regents of the Smithsonian Institution for the year ending June 30, 1905, together with a report of Mr. Richard Rathbun, the then acting secretary of the institution, for the year ending on June 30 last. Mr. Rathbun gives an account of the numerous activities of the institution during the year under review, and is able to record satisfactory progress. The general appendix of the regents' report contains as usual an admirable selection of papers by men of science of many nationalities, designed to furnish brief accounts of scientific discovery in particular directions. Among these papers we notice Sir William White's Friday evening address to the Royal Institution, on submarine navigation; Mr. G. T. Beilby's presidential address to the chemical section of the British Association at its South African meeting, on gold

in science and industry, Sir Harry Johnston's paper to the Royal Geographical Society, on Liberia; as well as other contributions by British workers in science The fine illustrations add greatly to the interest of the volume

A THIRD edition of "A Text-book of Plant Diseases caused by Cryptogamic Parasites," by Mr George Massee, principal assistant in the department dealing with cryptogams of the Royal Herbarium, Kew, has been published by Messrs Duckworth and Co

VOL IV of the Proceedings of the London Mathematical Society, second series, is now available The volume is published by Mr Francis Hodgson Among its contents may be mentioned the records of proceedings at meetings of the society, obituary notices of the late Astronomer Royal of Ireland, Mr C J Joly, F R S, and the late Mr Robert Rawson, sometime headmaster of the Dockyard School, Portsmouth, papers published in the Proceedings from November, 1905, to November, 1906, and several useful indexes Abstracts of papers brought before the society appear regularly among our reports of scientific societies and academies

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN APRIL —

April 3	5h 48m to 8h 55m	Transit of Jupiter's Sat. III (Ganymede)
7	16h 18m to 17h 1m	Moon occults γ Capricorni (mag 3 8)
10	9h 55m to 13h 2m.	Transit of Jupiter's Sat III (Ganymede)
13	11h 0m	Vesta in conjunction with the Moon (Vesta 0° 24′ N)
,,	12h 0m	Minimum of Algol (β Persei)
14	16h 0m	Mercury at greatest elongation (27° 36′ W)
16,	8h 49m	Minimum of Algol (β Persei)
18	6h 57m	Jupiter in conjunction with the Moon
20–22		Epoch of Lyrid meteor shower. Radiant 271° + 33°
21	2h 41m	Venus and Saturn in conjunction (Venus 0° 38′ N)
,,		Venus Illuminated portion of disc = 0 773
30.	15h 38m to 16h 50m	Moon occults ξ Ophiuchi (mag 4 5)

COMET 1907*a* (GIACOBINI) —No further observations of this comet have yet been received, but the elements and daily ephemeris computed by Herr M Ebell appear in No 4161 of the *Astronomische Nachrichten* (March 13), the latter extending to March 31 An extract is given below —

Ephemeris 12h (M T Berlin)

1907	α (true) h m	δ (true)	log r	log Δ	Brightness
March 27	6 27 4	− 3 34 3	0 3119	0 2474	0 67
29	6 24 9	2 16 4			
31	6 22 7	− 1 2 3	0 3122	0 2682	0 61

OBSERVATION OF COMET 1905 IV —A telegram from the Kiel Centralstelle announces a further observation of comet 1905 IV by Dr Kopff at the Königstuhl Observatory on March 21 The position of the comet at 14h 45 8m (Königstuhl M T) was

R A = 14h 58 6m, dec = 21° 18′ S,

and the magnitude was estimated to be 13 8

The above position lies in the constellation Libra, and is above the horizon from about 11 p m to 6 a m

This comet was first discovered, as 1906*b*, by Dr Kopff at Heidelberg on March 3, 1906, and was observed until June, 1906, the perihelion passage occurred on October 18, 1905 The orbit is remarkable for its great perihelion distance (3 3 R), which has only been exceeded by that of the comet of 1729 The motion is probably parabolic, although an elliptic orbit, having a period of 1153 years, has been suggested

STANDARD STELLAR MAGNITUDES —In order that astronomers may have a ready means of reducing their magnitude observations to a uniform scale, Prof Pickering publishes, in Circular No 125 of the Harvard College Observatory the positions and carefully determined photometric magnitudes of a selected sequence of stars in the region of the North Pole To determine the magnitudes of other stars the following method is suggested —Two photographs are taken, one of the polar region, the other of the region to be investigated, and on the former the standard stars, on the latter the stars the magnitudes of which are to be determined, are marked Then on a night when the atmospheric conditions are good and constant, and at a time when the second region is at about the same altitude as the pole, a third plate is successively exposed for exactly the same time on each of the two regions

Thus on the third plate the observer has the standard and unknown star images on the same plate taken under exactly the same conditions, and may recognise them by superposing, in turn, the two negatives first secured and marking off the required images These may then be compared for magnitude, and the results reduced to a standard scale by means of Prof Pickering's standard list

THE SPECTRUM AND RADIAL VELOCITY OF MIRA —In No 1, vol i, of the Journal of the Royal Astronomical Society of Canada, Mr J S Plaskett, of the Dominion Observatory, publishes the results of a spectrographic investigation of Mira during the most recent maximum The spectra were obtained with a three-prism Brashear universal spectroscope giving a linear dispersion at Hγ of 18 6 tenth-metres per millimetre, and having a resolving power of 40 000 The results obtained by measuring two plates are in good agreement with one another and with the results obtained by Prof Campbell and Mr Stebbins For the absorption lines a radial velocity of +65 6 km, reduced to the sun, was obtained, and as this is practically the value obtained by the other two observers mentioned, in 1897 and 1902 it appears that the receding motion of Mira in the line of sight is constant. The velocity, as determined from the bright hydrogen lines, is some 15 km less and Mr Plaskett suggests that this difference is probably due to some abnormal conditions of pressure, temperature, or electrical state in the atmosphere of the star

The present spectrograms show that titanium is undoubtedly represented in the spectrum of Mira, a point considered doubtful by Stebbins in 1902, and that the magnesium line at λ 4571, bright in 1902, is now represented by a normal absorption line Hβ is fairly strong as a bright line, but Hϵ cannot be seen on these spectra

TWO RAPIDLY-CHANGING VARIABLE STARS —In No 5 of the *Comptes rendus* M J Baillaud announced the discovery of two new variable stars of which the light changes were so rapid as to be shown on plates taken at the Paris Observatory with three successive exposures at intervals of half an hour During the period of observation one of these stars changed from magnitude 14 5 to magnitude 12 7 the other changed from 14 5 to 13 6. As there are not likely to be many photographic images of these faint objects they have been looked for on the Harvard photographs, and in Circular No 126 Prof Pickering publishes the information that has been gathered from thirteen plates

A NEW ASTRONOMICAL JOURNAL —We are pleased to be able to record that, with an increased grant from the Dominion Government, the Royal Astronomical Society of Canada has commenced the publication of a bi-monthly journal recording the proceedings of the society The first number (January and February, 1907) contains information regarding the society and several very interesting papers Among the latter may be mentioned two papers by Mr Stupart on magnetic storms and auroræ, the president's address on the astronomical work of 1906, and a paper by Mr Plaskett on the spectrum of Mira, referred to above

MODERN VIEWS OF THE ETHER

Introduction

IN putting into print once more the book called "Modern Views of Electricity," my object is to recall attention to the ethereal aspect of affairs, and to assist in the combination of those ideas with the comparatively recent notion of electrons on the strength of which such great advances have been made There are several additions to the book, and especially there is a concluding chapter which, since the other portions of the original book appeared in the columns of NATURE, may likewise be allowed so to appear It will be observed that, on the basis of a consistent working hypothesis therein, an attempt is made to estimate the absolute value of the two ethereal constants—a thing which I have for many years sought to do It will also be seen that, from the point of view adopted, the density of the ether comes out, not merely greater than platinum, as had several times been surmised, but very much greater in fact, something comparable to a billion times the density of water, and its intrinsic constitutional energy is correspondingly enormous

There is nothing paradoxical, nor, so far as I can see, improbable, about these figures Matter is an excessively porous or gossamer-like structure, and the inertia of matter must be a mere residual fraction of the inertia of the continuous incompressible complex fluid, of which it is hypothetically composed, and in which it moves

The following is the chapter referred to —

CONCLUDING CHAPTER OR SUMMARY

Structure of the Ether

What, then, is the conclusion of the whole matter, so far as a conclusion is possible at present?

The material universe seems to consist of a perfectly continuous incompressible and inextensible medium, filling all space without interstices or breach of continuity,—not of a molecular or discrete structure, and as a whole completely at rest as frictionless moreover, and unresisting to all ordinary motion of what we call matter through it, as is the mathematical conception—a perfect fluid But in spite of immobility as a whole, it possesses that property of "rigidity," or elastic resilience to "shear" which is characteristic of what we ordinarily call a solid, wherefore it would appear that it must be, throughout, in such a state of excessively fine-grained turbulent motion as would confer this property upon it And the resilience is so complete and instantaneous, without any delay or permanent set, that the elasticity must be described as "perfect" It is the gyrostatic kind of elasticity discovered dynamically and applied ethereally by Lord Kelvin, whereby a perfect fluid can kinetically acquire some of the properties of a perfect solid

It is well known that every solid possesses two kinds of elasticity—elasticity of bulk and elasticity of shape The first, or volume elasticity may also be called "the incompressibility" and is common to all forms of matter—fluid as well as solid In the case of the ether, however, the value of this quantity appears to be infinite it is, at any rate, greater than we have as yet been able to appreciate by specially directed experiments—meaning especially the Cavendish experiment referred to in §§ 4 and 14A The elasticity of figure, or shape-elasticity is only possessed by solids and is technically called "rigidity", it is small in the case of india rubber great in the case of steel or glass it is the property on which spiral springs and torsion-balances depend The two kinds of elasticity are quite independent of each other—quite independent also of anything akin to viscosity, which in the case of the ether appears to be zero

Now something analogous to shape-elasticity the ether possesses It does not possess ordinary mechanical rigidity, because that is an affair of molecules but it possesses something which may be called an electric rigidity, or electromotive elasticity It is identical with the electromotive elasticity of a dielectric—it is the property which causes recoil after charge and it has been denoted by $4\pi/\kappa$, where κ is the absolute Faraday's dielectric constant or specific inductive capacity for free space

The property thus analogous to rigidity, or shape-elasticity, is accompanied by another property, akin to inertia This is the property to which magnetism is due, it is a magnetic inertia, to pair with electric rigidity, and it has been denoted throughout by $4\pi\mu$, where μ is the absolute magnetic permeability of free space The self-induction of quasi-inertia associated with every electric current, of which $4\pi\mu$ is the non-geometrical and essential factor, is explicable, up to a point, as due to the magnetic field excited by electric motion, but it would seem as if ultimately it must necessarily be dependent on an unexplained and fundamental kind of inertia possessed by the ether itself, so that the ether may be said to have a certain density, or mass per unit volume,—something at least so like ordinary material specific-gravity or density that we have to call it by the same name

By reason of these two properties—electric elasticity and magnetic density—transverse electromagnetic waves are transmitted through and by the ether, at a perfectly definite and known speed This speed of wave propagation is far greater than any we are accustomed to in connection with matter, and if ever the motion of matter can be made to approach this speed, it must encounter a reaction or impedance or opposition to further acceleration, which ultimately, in the limit, amounts to a practically infinite obstruction, at the actual critical speed

This obstruction is not of the nature of friction,—it is not resistance proportional to the velocity or in any way dependent on the velocity it solely opposes acceleration, and is of the nature of impedance or inertia

The fact of inertia enables an oscillatory wave-process to go on in the ether, and endows those oscillations with a particular kind of alternating kinetic, as well as with potential, energy

The energy of strained or distorted ether is always potential energy, and is all the potential energy there is but accessible or convertible kinetic energy is usually only possessed by those individualised and discriminated regions or ethereal structures, which possess the power of locomotion, and which in their aggregate appeal to our senses as "matter"

During the passage of waves, the ethereal structure is sheared to and fro not with any movement as a whole, but with equal opposite movement of two aspects, or elements, or conditions, of its structure such shear being equivalent to what is called an electric displacement, and being subject to a restoring force accurately proportional to that displacement

This elasticity is "perfect" in free space, apart from matter, until a critical shear, of unknown value, is reached If strained beyond that, it may be supposed that a separation, or dislocation, or decomposition, of the ether into two components or constituents would occur,—constituents generated, as it were by means of the shear, and probably not existing, as such, in the unperturbed ether One of these components we call positive, and the other negative, electricity Once formed they do not disappear again they may combine—or approach each other so closely that they neutralise each other's effects at a distance, but they are still readily separable by electromotive force They do not combine in the sense of destroying each other—they do not re-form the original substance out of which they were produced

The negative electricity, when separated, is freely mobile and easily isolated it is what we experience as an electron The positive constituent does not appear thus in an isolated manner, but is only known to exist in a mass as if matted together and associated with an indistinguishable and inseparable aggregate of charges—opposite charges apparently in combination, going about as a whole Some of these aggregates may unite into larger ones others when too large may split up into smaller ones and so finally a set of sub permanent stable aggregates are formed, which we recognise as the atoms of the so-called "elements" of matter each with its appropriate degree of stability

These masses or aggregates may temporarily acquire or may lose, one or more of the free electrons and by thus becoming amenable to electrical or chemical attractions and repulsions constitute what we call "ions," so long as the unbalanced or electrified condition lasts

Massiveness of the Ether

Each electron, moving like a sphere through a fluid, has a certain mass associated with it, dependent on its size, and, at very high speeds, on its velocity also

Now how shall that mass be treated?

Shall we deal with it on the analogy of a sphere moving through a perfect irrotational liquid, without examining into details any further?

Or shall we consider it as generating circular lines of magnetic induction by its movement, by reason of the rotational properties of the ether, and attribute all its inertia to the magnetic whirl thus caused round its path treating the whirl as an actual circulation of fluid excited by the locomotion?

Both methods may be adopted, to see whether they will agree

Now treating it by the first method, and considering the electron merely as a sphere moving through a perfect liquid, its behaviour is exactly as if its mass were increased by half that of the fluid displaced and the surrounding fluid were annihilated It has been argued in the book, from the result of the Cavendish surface-charge experiment, and from the phenomena of gravitation, that the ether is incompressible, to a high degree of exactness, and accordingly the density of fluid inside and outside an electron must be the same So that, treating it in this simplest fashion, the resultant inertia is half as great again as that of the volume of fluid corresponding to the electron that is to say, is $2\pi\rho a^3$, where ρ is the uniform density If it is of some other shape than a sphere, then the numerical part is modified, but remains of the same order of magnitude

Now treat it by the other, or magnetic whirl, method

Let a spherical electron e of radius a be flying at speed u, so that the magnetic field at any point $r\theta$, outside, is

$$H=\frac{eu\sin\theta}{r^2},$$

and the energy per unit volume everywhere is $\mu H^2/8\pi$

It has been shown by Lord Kelvin, Mr Heaviside, G F FitzGerald, and Prof Larmor, that a magnetic field may be thought of, hypothetically, as a circulation of fluid along the lines of magnetic induction—which are always closed curves—at some unknown velocity w

Consider the energy per unit volume anywhere, it can be represented by the equivalent expressions

$$\tfrac{1}{2}\rho w^2=\frac{\mu H^2}{8\pi}=\frac{\mu}{8\pi}\frac{e^2u^2\sin^2\theta}{r^4},$$

wherefore

$$\frac{w}{u}=\sqrt{\left(\frac{\mu}{4\pi\rho}\right)}\frac{e\sin\theta}{r^2},$$

On the cog-wheel analogy the highest velocity will be that in contact with the moving charge, and there is some reason to suppose that the maximum velocity w at the equator of the moving sphere may be equal to the speed u Elsewhere it will decrease with the inverse square of the distance just as H decreases

But without any hypothesis, if there be a circulation at all its velocity must be a maximum at the equator of the sphere where $r=0$ and $\theta=90$, so, calling this w_0,

$$\frac{w_0}{u}=\sqrt{\frac{\mu}{4\pi\rho}}\cdot\frac{e}{a^2},$$

and

$$\frac{w}{w_0}=\frac{a^2\sin\theta}{r^2},$$

and therefore the major part of the circulation is limited to a region not far removed from the surface of the electron

The energy of this motion is

$$\tfrac{1}{2}\rho\int_0^\pi\int_a^\infty w^2 \quad 2\pi r\sin\theta \quad rd\theta \quad dr,$$

or substituting the above value of w the energy comes out equal to $\frac{4}{3}\pi\rho a^3 w_0^2$

Comparing this with a mass moving with speed u,

$$m=\frac{8}{3}\pi\rho a^3\left(\frac{w_0}{u}\right)^2$$

This agrees with the simple hydrodynamic estimate of effective inertia, if $w_0=\frac{1}{2}\sqrt{3}u$, that is to say, if the whirl in contact with the equator of the sphere is of the same order of magnitude as the longitudinal rack-motion or cog-wheel spin at the same place

Now for the real relation between w_0 and u we must make a hypothesis If the two are considered equal, the effectively disturbed mass comes out as twice that of the bulk of the electron If w_0 is much smaller than u, then the mass of the effectively disturbed fluid is much less even than the bulk of an electron, and in that case the estimate of the fluid-density ρ must be exaggerated enormously, in order to supply the required energy It is difficult to suppose the equatorial circulation w_0 *greater* than u, since it is generated by it, and it is not unreasonable to treat them both as of the same order of magnitude So, taking them as equal,

$$e=a^2\sqrt{\frac{4\pi\rho}{\mu}}$$

and $m=$ twice the spherical mass

Hence all the estimates of the effective inertia of an electron are of the same order of magnitude, being all comparable with that of a mass of ether equal to the electron in bulk

This would also be the conclusion drawn, if, instead of integrating the magnetic energy from a to infinity, we integrated from a to a larger radius b, or say na, the inertia would then come out

$$\tfrac{2}{3}\mu e^2\left(\frac{1}{b}-\frac{1}{a}\right) \text{ or } \frac{2(n-1)}{3n}\frac{\mu e^2}{a},$$

and be still of the same order of magnitude for all reasonable values of n, the reason being that all the effective disturbance is concentrated in the neighbourhood of the charge

Now the linear dimension of an electron is 10^{-13} centimetre diameter, and its mass is of the order 10^{-27} gram, being about the 1/700th part of the atom of hydrogen Consequently, if its mass were due to its contents, the density of its material must be of the order

$$10^{-27}\div 10^{-39}=10^{12} \text{ grams per cubic centimetre}$$

This, truly, is enormous, but any reduction in the estimate of the circulation speed, below that of an electron, would only go to increase it, and since electrons move sometimes at a speed not far below that of light we can not be accused of underestimating the probable velocity of magnetic spin by treating it as of the same order of magnitude, at the bounding surface of the electron a relation suggested, though not enforced, by the cog-wheel and gyrostat analogy

Incidentally, we may notice how enormous is the magnetic field surrounding the equator of an electron moving along an axis with, say, one-thirtieth the speed of light it amounts to 10^{15} C G S lines per sq centimetre And the magnetic energy there is correspondingly enormous, being 4×10^{28} ergs per c c At the velocity of light it would equal the constitutional energy of the ether itself

Value of the Ethereal Constants

It has been argued throughout the book that the ethereal density is what we know in magnetism as $4\pi\mu$, wherefore an approximate estimate of the absolute value of the magnetic constant μ for free space, on this view, is 10^{11} grams per c c

Using the value $4\pi\mu=\rho$, we get for the charge of an electron

$$e=4\pi a^2,$$

or comparable to its superficies.

The speed with which waves travel through the medium is the square root of 10^{21} C G S, consequently the elasticity of the ether must be of the order 10^{33} dynes per square centimetre, which is what in static electricity we denote by $4\pi/\kappa$ Wherefore an approximate estimate of

the absolute value of Faraday's dielectric constant κ, for free space, is 10^{-33} cubic centimetre per erg

In other words, the intrinsic energy of constitutional motion of the ether, to which its rigidity is due, is of the order 10^{33} ergs or 10^{26} Joules per cubic centimetre—about a hundred foot lbs per atomic volume, which is equivalent to the output of a million horse-power working for forty million years, in every cubic millimetre of space It can otherwise be expressed as the energy of a thousand tons per cubic millimetre, moving with the velocity of light, but of course the motion really contemplated is all internal and circulatory

Transmission of Waves

Wherever electrons and atoms exist, they modify the ether in their immediate neighbourhood, so that waves passing through a portion of space containing them are affected by their presence, as if the ether were more or less loaded by them, because the electric displacements which go on in the unseparated and still perfectly united constituents of free ether are also shared to some extent by the separated peculiarities especially by those of the electrons which are not too embedded in or surrounded by a positive charge—for instance, like a nucleus in a shell These might be inert and without influence on the light, except as small fixed mechanical obstructions but all those charges which possess externally-reaching lines of force must share in the motion of the waves, without having the requisite amount of resilience to compensate for their inertia consequently they, to that extent, constitute a retarding, and either an absorbing or a reflecting agency

Furthermore their motions of vibration and rotation during the epochs of acceleration, however caused encounter the inertia of the medium, and thereby excite waves in it—waves of oscillatory electric displacement with magnetic concomitant—and this electromagnetic radiation is transmitted out into space but it is insignificant in amount unless the acceleration is violent It is proportional to the square of the acceleration

The positive and negative constituents, when they combine or cohere do not destroy each other and revert into plain ether again, on the contrary, they retain their individuality and persist in either a combined or separate state We do not know how to produce or to destroy these peculiarities, and though atoms of matter are composed of them and though all electrical phenomena and the excitation of radiation are due to their presence and behaviour it is no more and perhaps not much less correct to say that the main bulk of the ether is composed of them than it is to say that actual sodium and chlorine exist in undissociated common salt These elements only make their appearance when the original substance is decomposed But certainly matter can be dissociated with extreme ease, whereas the dissociation of ether is unknown and hypothetical, save as represented by its apparent results

Nevertheless it must be the case that the slight, almost infinitesimal, shear which goes on in a light wave, is of the nature of incipient and temporary electric separation and all electromotive force *tends* to drive one constituent in one direction and the other in the other thus beginning that individualisation or separate manifestation of the two ingredients, without a knowledge of which the original fluid would have appeared to be of a perfectly uniform and homogeneous character

It is quite possible that the actually double aspect of ether is not only manifested but really generated by an electromotive force applied to it, just as the elastic recoil is so generated It appears possible that a sufficiently violent E M F applied to the ether, by some method unknown to us at present, must be the kind of influence necessary to shear it beyond the critical value and leave its components permanently distinct such constituents being opposite electric charges which when once thoroughly separated only combine to form matter, and do not recoil into ordinary ether again

Hypothetical Longitudinal Stress

Every attempt at separation of this kind, even if no stronger than exists in ordinary light, seems to be accompanied by a slight longitudinal force at right angles both to the displacement and to the orbital axis of the excursion —a force which is known as the normal pressure of light, or Maxwell's pressure, perpendicular to an advancing wave-front the inertia of the constantly encroached upon region of free ether having the effect of momentum

If the disturbance could be made so extreme as to result in permanent dislocation this pressure might leave behind it, as permanent residue, a longitudinal pressure, extending throughout space inversely as the distance, whereby all the dislocated material would thereafter be urged together with a force which we know as gravitation, proportional in any piece of matter to the number of dislocated centres which go to compose it, and therefore proportional to its mass irrespective of secondary accidents of a physical or chemical constitution

Amplitude of Light Wave

If a is the amplitude of shear during the passage of a wave of light, and if u is the maximum velocity of recovery, then

$$\frac{u}{v} = 2\pi\frac{a}{\lambda},$$

where v is the velocity of light and λ the wave-length The total energy per unit volume is $\frac{1}{2}\rho u^2$ where ρ is the density of the medium, for this represents twice the average kinetic energy, and of this quantity one half is really kinetic, the other half potential

Now direct thermal measurements, such as those conducted by Pouillet, give us the energy of sunlight near the earth 4×10^{-5} erg per c c and consequently, in the region of intense light near the solar surface the energy of radiation must be about 2 ergs per cubic centimetre There may be more intense light than this, but this is the most intense we know of so it is instructive to consider the amplitude of the shear corresponding to such violent illumination Let us therefore put $\frac{1}{2}\rho u^2 = 2$ whence

$$u^2 = 4\times10^{-12}$$

It follows therefore, that

$$u/v = \tfrac{2}{3}\times10^{-16}$$

and accordingly the amplitude of the most intense visible light we are acquainted with, is only 10^{-17} of a wave-length The maximum strain is 2π times this fraction, and so the tangential stress thus called out in the medium its rigidity being 10^{33}, may be estimated as comparable with 10^{17} dynes per square centimetre or 10^{11} atmospheres

The ordinary electrostatic unit of charge on this estimate of ethereal elasticity becomes 10^{-16} square centimetre or the superficial dimension of an atom This also corresponds with the estimate above that the electronic charge is equal to the superficies of an electron, since one should be 10^{10} times the other

The pressure of light has been represented by Prof Poynting as a travelling momentum like that of a jet of water resulting in a pressure ρcv where c is the velocity of longitudinal motion or circulation in the light beam, and v is the velocity of light Taking the pressure of intensest light as 2 dynes per square centimetre this gives $c = \tfrac{2}{3}10^{-22}$ centimetre per second excessively small therefore, even in that extreme case

Hypothetical Flow along Lines of Magnetic Induction

It has long been a working hypothesis with some mathematical physicists (see, for instance, the ensuing April number of the *Philosophical Magazine*) that there was probably something of the nature of a flow—an ethereal flow—along lines of magnetic induction, and the fact that these are always closed curves in all known circumstances, is in favour of such an idea The energy of the field would then be attributable to the energy of this flow and though it is possible that the flow might be of the nature of components moving in opposite directions the movement is hardly likely to be of this nature since that would correspond with merely an electric current

Fourteen years ago, in 1893, having rather perfect appliances for examining the effect of drift on the velocity of light, I carefully looked for some longitudinal flow along lines of magnetic force, repeating the experiments

still more anxiously when I learnt that something of the kind was seriously suspected by Dr Larmor

Applying a field of 1400 C G S units over a length of light path of about 14 metres in the aggregate, things were so arranged that a drift of 1 foot a second, or about 10^{-9}th of the velocity of light, would have been observed by a fractional shift of micrometrically viewed interference bands, if it had occurred But no effect whatever on the interference bands could be detected, nor was anything observed when—with less perfect vision, in that case, owing to increased difficulties—the air along the field and path of light was replaced by bisulphide of carbon, except that, of course, if plane-polarised light was used, the plane was then rotated by a very large amount Sufficient details of this series of negative experiments will be given in the forthcoming April issue of the *Philosophical Magazine*

The result was to show that if the magnetic energy were to be accounted for in the assumed kinetic fashion, the density of the ether must be very considerable—in fact about 180 times that of water—in order to give the actual energy with a velocity below what could be observed in this way

I have now, however, as described above made a theoretical estimate of the density of the ether—arriving at the tentative conclusion that it is of the order 10^{12}—and we can therefore proceed to calculate what velocity of hypothetical ethereal drift is to be expected in any given magnetic field It will come out, of course, exceedingly slow, for, on this view, the electromagnetic unit of field is $\mu^{-\frac{1}{2}}$, which equals 3×10^{-8} centimetre per second, and the velocity to be expected is the 2πth of that

So, for instance, the field inside a solenoid, surrounded by a current of 100 amperes circulating 100 times round every centimetre of it, being $4\pi n_1 C$, will equal 12,000 C G S, which corresponds with a velocity of 0.003 centimetre per second, or about 4 inches an hour In fact, the ampere turns per inch, in any solenoid, measures the speed of magnetic circulation along its axis, no matter what the material of the core may be, in millimicrons per second

When iron is substituted for air the speed is the same, but the ethereal density is virtually increased, by the loading due to the molecular whirls in the iron

It may seem difficult to reconcile this very slow velocity, in any ordinary field, with the great velocity of the very same character already postulated in the immediate neighbourhood of an electron, where it is supposed that the magnetic circulation is equal to, or at any rate of the same order of magnitude as, the locomotion speed—which it is well known may easily be 1/30th of the velocity of light without departing appreciably from the simply calculated inertia But that great speed in the immediate neighbourhood of an electron, can be fully admitted and there is nothing really inconsistent in that with the slow speed observed at any ordinary distance For instance, if close to the equator of a flying electron, the ethereal magnetic speed is 1/30th of the velocity of light, or 10^9 centimetres per second then, at a distance of 1 millimetre away the speed is reduced to 10^{-24}th of that value and is therefore even at that small distance, only 10^{-15} centimetre per second, or 3 millimicrons per thousand years

The speed at the axis of a solenoid is, of course, far greater than that, because of the immense number of electrons in any ordinary current surrounding it, but, in order to get up a drift-velocity of 1 centimetre per second in a solenoid a thousand amperes would have to circulate three thousand times round every centimetre of it, which seems hardly practicable

The optical arrangements in my experiment above spoken of, could doubtless be improved sufficiently to show an ether drift of 1 centimetre per second, but I do not see how to produce a field of the required intensity to give even this leisurely flow Such a field would have to be about four million C G S units, and must exist throughout a great length of air

The experimental verification of the above theoretical estimate of ethereal density seems therefore to be beyond the reach of this form of experiment Nevertheless, I feel reasonably convinced that there is a justification for assuming the ether to have properties such as can only for the present be represented, in analogy with the properties of matter, by saying that its behaviour consistently indicates something typified by its possession of an immense elasticity or rigidity, 10^{33} dynes per square centimetre, caused by its intrinsic constitutional energy; combined with a property analogous to, and resulting in, material inertia, and typified by attributing to it a density of the order 10^{12} grams per cubic centimetre The ethereal property, here called elasticity, is certainly the source and origin of every kind of material elasticity and potential energy, for the only real static effect producible in the particles of matter is a change in their arrangement or configuration All stress must exist really in the ether

Although the experimental methods so far suggested have proved themselves unable to test the magnitudes involved in these high values, some other method of inquiry may be suggested, and the theory may yet be brought to the test of experiment OLIVER LODGE

THE INSTITUTION OF NAVAL ARCHITECTS

THE annual spring meeting of the Institution of Naval Architects was held last week at the Society of Arts, commencing Wednesday, March 20, and being continued over the two following days Fourteen papers were read and discussed, some of them at considerable length, while Lord Glasgow's presidential address, the report of the council, and other necessary business received due attention

The first paper taken was a contribution by Mr James McKechnie, of Barrow, the subject being the influence of machinery on the gun-power of the modern warship This paper was full of information, but perhaps the most interesting part was that in which the author compared the elements of design of three imaginary battleships, propelled respectively by steam, gas, or oil engines It is somewhat startling to find the chief engineer of one of our most powerful shipbuilding and engineering companies—and one, too, so largely engaged in the production of war material—should think gas or oil engines as propulsive agents for the largest warships, sufficiently within the possibilities of the near future as to make it the subject of a paper before this important institution, it is prophetic of still vaster changes in store than even the transition from shell boilers to water-tube boilers, and from reciprocating engines to the steam turbine Mr McKechnie, however, intimated during the discussion on his paper that his company, Vickers, Sons and Maxim, was quite prepared to build a warship with gas-producers in place of boilers, and gas engines in place of steam engines, if any Government had the courage to give them an order It would seem almost that steam's unconquerable arm is likely to have its supremacy challenged even in that field where we have hitherto held it to be most secure

Mr McKechnie takes for his comparison the designs of three battleships, each of 16,000 horse-power The one propelled by steam would have machinery that would develop 10.1 horse-power per ton weight of machinery, the gas-driven machinery would give 14.48 horse-power per ton, whilst the oil engines and machinery would give off 21.33 horse-power per ton Probably an oil-engined battleship may be considered outside the bounds of practical engineering application until oil fuel becomes far more plentiful than there appears to be any prospect of it being at present, waiting, of course, that gloomy but undefined era when the coal supplies of the world are exhausted If, however, we confine ourselves to coal fuel, it is certainly a tempting offer which the engineer offers to the naval architect, this increase of nearly 50 per cent in the power developed on a given weight There are, however, other inducements With the steam engine the area occupied by machinery per unit of power is 0.453 square foot, whilst of the gas engine but 0.336 square foot is needed for each horse-power developed That also is a very substantial gain in a battleship, where every inch of space is so costly to produce and so urgently needed

The third chief consideration Mr McKechnie brings forward is fuel economy Steaming at full power, the coal

burnt would be 1·6 lb per indicated horse-power with one ship, whilst the sister vessel would be "gassing" (we shall have to become reconciled to the objectionable term) with a consumption of 1 lb of coal per indicated horse-power per hour. Here is a saving of more than 50 per cent. in weight of coal carried, bunker space, time of coaling, and other subsidiary matters, amongst them money cost. At lower powers the figures bear approximately the same ratio.

These are enormous strategical advantages, but the tactical benefits offered are hardly less pronounced. By means of profile views the author showed the gun emplacements of the two ships. With the usual two-chimney arrangement of the steam ship, there are four 12-inch guns placed in pairs in two barbettes at the ends of the battery as is usual. These have arcs of training, a few degrees before or abaft the beam respectively, whilst the weapons of a lighter nature can only fire on their respective broadsides. When we turn to the ship without boilers—the gas-engine ship—we find the space that would be taken in the other vessel by funnels, uptakes, &c., occupied by three additional barbettes placed *en echelon*, and each containing two 12-inch guns. There are also the two end barbettes with their four guns, as in the steam ship. These six centrally placed guns can be, moreover, trained on either broadside, so that, in an encounter between the steam ship and the gas ship the latter could bring ten 12-inch guns into action as against four of the former vessel, supposing the encounter to be broadside on; or, to put the case another way, the gas ship could fight a steam ship on each broadside, and have a superiority over her enemies of two 12-inch guns. With secondary armament the problem is more complicated, and could hardly be explained without diagrams.

What, it will be asked, are the defects of these qualities? and an answer can only be given by the light of experience—an experience only likely to be gathered by steps. The marine steam engine has been brought to such a state of efficiency that its performance can be practically depended upon; this is not the case with the producer gas engine. There are many things to find out yet, the problem being more complex from the combination of mechanical and chemical sciences that have to be applied. With gas engines afloat—a very different thing from gas engines ashore supplied from a central source—one hears of the explosive mixture failing, from unexplained causes, and the engines stopping without warning, and there are details of working connected with ignition and other points which have yet to be perfected. For much the same reason that many naval engineers prefer hydraulics to electricity for working armaments steam is likely to be preferred to gas for propelling battleships. Which will ultimately survive time will show; in the meantime it may be said Mr. McKechnie has worked out a very strong case for gas.

The remaining paper taken on this day was by Mr. Simon Lake, who dealt with the subject of submarine boats. The type of vessel the author advocates is fairly well known, its most striking characteristic being that it is fitted with wheels so that it can travel along the bottom of the sea. The paper gave an interesting account of some of Mr. Lake's adventures in his ingeniously devised craft.

On the second day of the meeting Mr. W. J. Luke, of Clydebank, read a paper in which details of certain points in the construction of the new big Cunard ship *Lusitania* were set forth. The chief point was the application of high tensile steel in the upper part of the hull structure, a detail of shipbuilding design which possesses definite advantages, seeing that the hogging stresses are more serious than the sagging stresses, and therefore tension is of high importance for the upper member of the girder formed by the hull structure. The evolution of the modern cargo steamer was the subject of a paper by Mr. S. J. P. Thearle, of Lloyd's. It was a contribution that will be of value in the Transactions of the institution for future students of the history of shipbuilding. Cranes for shipbuilding afforded a subject of practical interest for Signor C. Piaggo.

The two papers that were read at the evening meeting of the same day were both of interest and importance. They described two forms of instrument for measuring the power given off by turbines. The author of the first paper was Mr. A. Denny, and of the second Mr. J. H. Gibson. As is well known, the ordinary steam-engine indicator, by which horse-power has been measured since the days of James Watt, is useless for application to turbines, because there is no reciprocating motion with the latter. This has been a serious obstacle in the path of ship designers, but it appears to have been overcome by taking indicators of the torsion of the shafting through which power is conveyed from the turbine to the propeller. In both the instruments described by the authors of the two papers recourse is had to this means, but the method of recording is different. In the Denny and Johnstone torsiometer is an electrical method in which a telephone is used, whilst in Mr. Gibson's instrument recourse is had to a flash of light deflected by a mirror. The details by which these processes are made practical have been worked out in each case with great ingenuity, but it would be difficult to make them clear without illustrations. It may be pointed out, as Lord Glasgow stated at the meeting, that the successful application of these instruments will solve a problem that the elder Froude worked out with much enthusiasm during the later years of his life, though with very partial success. A paper on propeller struts, by Mr. G. Simpson, was of purely professional interest.

One of the most interesting papers of the meeting was Sir William White's contribution on experiments with Dr. Schlick's gyroscopic steadying apparatus. This paper is of such interest that we propose to deal with it separately. Its full comprehension, however, involves a knowledge of the principles set forth in a paper read by Dr. Schlick a few years ago, Sir William having thought it unnecessary to go over the same ground again.

The other papers read were on the approximate formulæ for determining the resistance of ships, by A. W. Johns; on the application of the integraph to ship calculations, by J. G. Johnstone; on the prevention of fire at sea, by Prof. Vivian B. Lewes; on modern floating docks, by Lyonel Clark; and on some phases of the fuel question, by Prof. Vivian B. Lewes.

The institution will hold a summer meeting in Bordeaux towards the end of June.

TICKS AS TRANSMITTERS OF DISEASE.[1]

MANY statements are found in medical works as to the local poisonous effects of tick bites, but these are of small importance compared with the diseases inoculated by ticks. Until a year or so ago ticks were only known to transmit one kind of disease, and this was confined to the lower animals. Of these diseases, "Texas" fever in cattle may be regarded as the type. These diseases, which are met with in cattle, horses, asses, sheep and dogs, are due to parasites which attack the red cells of the blood. The parasites are characterised by their pear shape, and hence were originally called Pyrosoma, but this name has now generally been replaced by Piroplasma, and the infection by these parasites is known as piroplasmosis.

Smith and Kilborne in America, by their classical researches, first established the fact that Texas fever in cattle was transmitted by ticks. We may consider the mode of transmission somewhat more closely. Ticks in their life-history go through the stages of eggs, larva, nymph, and adult. In the case of transmission of malaria by certain Anophelines, we know that the adult mosquito when it has fed on the blood of a malarial patient can transmit the disease again after the lapse of ten days more or less, to a healthy person. Very different, however, is the mode of transmission of piroplasmosis by ticks. Smith and Kilborne showed that Texas fever was transmitted from the sick to the healthy animal, not by adult ticks, but that it was young ticks hatched from the eggs

[1] "Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India." New series No. 23. "The Anatomy and Histology of Ticks." By Capt. S. R. Christophers. Pp. 55+plates. (Calcutta: Office of the Superintendent of Government Printing, 1906.) Price 4s. 6d.
Memoir xxi of the Liverpool School of Tropical Medicine. September 1906. Pp. xiv+118+plates. (London: Williams and Norgate.) Price 7s. 6d. net.

of ticks found on diseased animals that transmitted the infection. The transmission is thus hereditary, and of a transmission of this kind we have no evidence at all in the case of malaria, though it has been stated that this mode of transmission occurs in yellow fever.

The transmission of Piroplasma by ticks is thus peculiar, and when we come to examine the known facts closely the peculiarity increases. Smith and Kilborne, as we have stated, showed that the infection of Texas fever due to *P. bigeminum* was carried by ticks in their larval stage. In the case of *P. canis* producing malignant jaundice in dogs the mode is different. In this case it is not the larva, but the adult tick of the second generation that transmits the disease. This also is the case for red-water of sheep due to *P. ovis*. In the case of piroplasmosis of the horse the mode has not yet been definitely established. Finally, in the case of "African coast fever" in cattle, a disease resembling in some respects "Texas" fever, but due to a different Piroplasma, viz. *P. parvum*, we appear to have a still more complex state of things. The transmission, according to Lounsbury, in the case of the tick (*R. appendiculatus*) is not hereditary, but is transmitted by nymphs which in the larval stage have fed on infected animals and also by adults which in the nymphal stage have fed on infected animals. Hence it is clear that analogy as a guide is almost useless, and it must be determined by actual experiment how in each case the transmission is brought about. Of the actual changes undergone by the Piroplasma in the tick, egg, larva, nymph, as the case may be, we know but little.

Recently, however, Koch described peculiar forms in the stomach of the tick which he considers to represent a cycle of development. Other forms have also been found in the egg, but not so far in the larva or nymph. No doubt research will be in the future directed to these points.

Piroplasmosis is, then, an important set of diseases transmitted by ticks, but, further, they have been recently shown to play a part in the transmission of those minute, slender, corkscrew-like parasites known as Spirochætes. These parasites give rise in man to a dangerous and often fatal fever, a marked character of which is the tendency to relapse. Hence it is known as recurrent or relapsing fever. The cause of relapsing fever has been long known to be a Spirochæte, viz. *S. obermeieri*, but it is only recently that the nature of "African tick fever" has been elucidated. This is also due to a Spirochæte, and as it is different from the former it has been named *S. duttoni* after the late Dr. Dutton, who with Todd was the first to elucidate the mode of transmission of the disease. The memoir of the Liverpool School of Tropical Medicine contains an elaborate study clinical and experimental of the characters of this Spirochæte. Perhaps the most convincing proof brought that these two Spirochætes are different lies in the fact that an animal that has recovered from an attack of the one is still susceptible to inoculation with the other, and *vice versâ*. How the ordinary relapsing fever is transmitted is still uncertain; it may be by bugs, though the numerous experiments recorded in this memoir to transmit *S. duttoni* in this way have all failed, but ticks are the transmitters of *S. duttoni*, and in Africa the particular tick implicated is *Ornithodoros moubata* (Murray). This tick, long of evil reputation, can transmit the disease in the following ways:—(1) directly, i.e. by means of adults that have sucked the blood of infected patients, and (2) by the nymphal descendants of these adults. Spirochætes have also been found by Koch in the eggs of ticks, but whether or no they undergo any development is at present unknown.

From what we have said it will be evident that to the medical man a knowledge of ticks is of the utmost importance, and every medical man will welcome this memoir of Captain Christophers on the anatomy and histology of ticks. The histological portion will be especially useful, as the systematic treatises, e.g. Neumann's memoirs, deal solely with the external characters on which their classification is founded. The internal anatomy of ticks has until quite recently been described in a very meagre fashion, and it is evident that such a knowledge is absolutely necessary in the search for developmental forms of Piroplasma and Spirochæta in the various tissues.

Those who are acquainted with Captain Christophers's previous work on the anatomy and histology of the mosquito will know what to expect in this memoir.

The clear descriptions, illustrated by numerous diagrams and six photogravure plates, might with advantage be imitated by other recent writers on the same subject.

With regard to the plates, unfortunately in passing through the press the lettering of many of the figures has not appeared. We may note also that the secretion from the coxal glands was observed by Dutton and Todd in the Congo.

The Liverpool memoir, besides the study of *S. duttoni*, contains a description of various attempts made to cultivate this Spirochæte, but all in vain. A new Spirochæte in the mouse, *S. laverani*, is also described. Two papers on Trypanosomes, and a number of pictures of the research laboratories at Runcorn of the Liverpool Tropical School, complete a very interesting memoir.

J. W. W. STEPHENS.

TROPICAL BOTANY.

AN interesting number of the Annals of the Royal Botanic Gardens, Peradeniya (London: Dulau and Co.), has just appeared. In the first paper Mr. R. H. Lock gives the third instalment of his work on plant-breeding in the tropics, dealing with maize. Unlike some Mendelian experiments, the results have been obtained with large numbers, and on a total, for instance, of 111 697 seeds, the result was 50.17 against an expectation of 50.11.

The second paper is by Mr. T. Petch on the fungi of the nests of the common termites, or white ants, of Ceylon, a worthy successor of Moller's classical paper on the fungi of the leaf-cutting ants of South America. He has worked out in detail the entire life-histories of the fungi, and shows that while the "regular" fungus is a Volvaria (already described elsewhere, as are so many of the tropical fungi that have only been worked at in Europe, under at least six genera), the garden also contains "weeds," one of which, at least, a Xylaria, is impossible of eradication by the ants. Incidentally, grave doubt is thrown on Moller's theory of selection of the fungus by the ants, for the "Kohl-rabi heads" occur in the termite nests in an even more perfect and complex form than in the leaf cutters' nests, and yet the same form appears on an allied outside fungus not cultivated by the ants. The paper is well illustrated.

The third paper is by Dr. Willis, on the flora of Ritigala. This is an isolated mountain in the "dry" zone of Ceylon, forty miles from any other, and high enough to condense much moisture on the top, where are found 103 species not otherwise known in the dry zone. These, being species of the lower zone of the southern mountains, must have leapt the whole forty miles in one operation. Among them are twenty-four bird-carried things, with one very slightly marked endemic variety among them; forty-nine wind-carried things (including twenty-four ferns), with two endemic species and one variety; and thirty plants the mode of distribution of which may be called doubtful or accidental. Six of these are low-country plants which might come by easy stages, and of the remaining twenty-four no less than nine are endemic to Ceylon and to the couple of acres of the summit of Ritigala. One of these nine has been found in South India, but the other eight are confined to Ritigala. This goes to show, therefore, that endemism goes with difficulty of distribution and rare arrival in one spot.

The final paper is by Mr. A. M. Smith, who has followed up Blackman's already almost classical paper on optima and limiting factors by a careful study of growth under different conditions in Ceylon—where it is rapid, and can be easily measured—and finds that Blackman's theory explains matters well. In Dendrocalamus (giant bamboo) at Peradeniya the limiting factor is humidity, while at night at Hakgala, where it is cold, the temperature is limiting and humidity has no effect. This work explains, but renders practically valueless, the enormous mass of observations on growth made by physiologists from Sachs onwards, and no one interested in physiology can afford to leave this paper unread. It also helps to show what an opening there is for really good physiological work in the tropics. The whole number is one of considerable interest and importance, and cannot be neglected by botanists.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MR J E S MOORE has been elected to the chair of experimental and pathological cytology, recently established in the University of Liverpool by the Liverpool Cancer Research Committee

A SERVICE for members of the University of London will be held in Westminster Abbey on Wednesday, May 8, presentation day, at 6 p m The Dean of Westminster has consented to preach the sermon

PROF M D'OCAGNE, of the École des Ponts et Chaussées, will deliver in April, at the University of Paris, a free course of lectures on graphic calculus and nomography In the second part he will give for the first time in a public lecture a complete account of his own methods on the subject

MR BIRRELL announced in the House of Commons on March 23 that the Treasury has agreed to place at the disposal of Ireland a sum of 40,000*l* a year for a period of three years to assist to remedy the present disgraceful condition of Irish school buildings There is no intention of stopping the grant at the end of three years, but it is felt, Mr Birrell said, that 40,000*l* is as much as can be spent profitably and usefully in a year

WE have received an interesting description of the central electric power station of the Victoria Jubilee Technical Institute Byculla, Bombay, which was opened by the Governor of Bombay on February 20 The installation, the first of its kind in India, is thoroughly up to date, and it is interesting to note that the erection of the boiler, engines, dynamo and motors, as well as all piping and wiring work, was carried out by the institute students

IN the *Engineering Magazine* (vol xxxii, No 6) Commander W I Worthington discusses the United States Naval Academy as an engineering school With the aid of numerous excellent photographs he shows the number, variety, and interesting character of the practical exercises and expresses the opinion that the academy graduate at the end of a term of years after graduation should rank high among engineers of his own age from other schools no matter what branch of the work he might take up

A CIRCULATING library from which the most recent scientific and technical books may be obtained without trouble and at a moderate expense is a great convenience alike to teachers and students of science Mr H K Lewis of Gower Street, London W C, has realised this fact and his recently published list of medical and scientific books issued during the last quarter of 1906 shows that he makes every effort to keep his library up to date, and that the conditions under which books may be borrowed have been made as simple as possible

IN connection with the Federal Educational Conference which the League of the Empire has arranged for May 24 the nature-study section intends to make (for the benefit of the colonial representatives) an exhibit typical of nature study work in this country The section will also meet during the week devoted to the conference in order to discuss matters connected with the promotion of nature-study Suggestions as to topics that might be considered should be sent to Mr Wilfred Mark Webb (honorary secretary of the nature-study section) at Caxton Hall, Westminster

THE organising committee of the International Congress for Hygiene and Demography which is to be held in Berlin on September 23–29 is making arrangements to render it possible for members of the congress to visit the numerous hygienic institutions in and near Berlin The meetings of sections will not be extended later than 2 o'clock, so as to leave the afternoons free for visiting More than a hundred institutions will be thrown open to visitors, and a "Hygienic Guide" giving a short description of each of them in three languages is to be published, so that members of the congress will be assisted in choosing which institutions they will inspect A local committee composed of representatives of interested Imperial and State offices the Berlin Council, and other bodies and societies, is actively engaged in preparing for the congress

THE President of the Board of Agriculture and Fisheries has appointed a departmental committee to inquire as to the provision which has now been made for affording scientific and technical instruction in agriculture in England and Wales and to report whether, in view of the practical results which have already been obtained, the existing facilities for the purpose are satisfactory and sufficient, and, if not, in what manner they may with advantage be modified or extended The committee will be constituted as follows, viz —Lord Reay (chairman) the Lord Barnard Lord Moreton, Mr F D Acland, M P, Mr D Davies, M P Mr N Lamont M P Mr T Latham Mr J C Medd Prof T H Middleton, Prof W Somerville and Mr H Staveley-Hill, M P Mr A E Brooke-Hunt, of the Board of Agriculture and Fisheries will act as secretary and Mr H L French, of the Board of Agriculture and Fisheries as assistant secretary to the committee

THE general committee responsible for the arrangements in connection with the second International Congress on School Hygiene, to be held under the presidency of Sir Lauder Brunton in London next August is sparing no pains to make the congress a complete success A meeting to promote the interests of the congress was held on March 20 at the Mansion House, and was well attended Sir Lauder Brunton explained the objects in view and gave a detailed description of the groups of subjects to be considered by the congress There will be eleven sections as follows the physiology and psychology of educational methods and work medical and hygienic inspection in school, the hygiene of the teaching profession instruction in hygiene for teachers and scholars physical education and training in personal hygiene out-of-school hygiene and the relations of home and school, contagious diseases, ill-health, and other conditions affecting attendance special schools for the feeble minded special schools for blind deaf, dumb, crippled, and invalid hygiene of residential schools the school building and its equipment Already the donations promised and received reach 927*l* Further subscriptions are solicited and should be sent to the treasurer Sir Richard B Martin, Bart, at the Congress Office, Royal Sanitary Institute, Margaret Street London, W

MR MCKENNA M P, President of the Board of Education was present at the annual dinner of old students of the Royal School of Mines on Tuesday, and in the course of a speech he made the announcement that the school is to retain its name and individuality in the Royal Technical Institute to be established at South Kensington Mr D A Louis presided at the dinner, and in proposing the toast of the evening "Prosperity to the School of Mines" he said it is of vital importance that there should be a well-equipped national institution for the training of mining engineers, and that the institution should grant a distinctive diploma The Royal School of Mines is such an institution yet it has been proposed to relegate it to some hole-and-corner place in a big jumble of institutions which have nothing in common with it excellent though they are in their own way Mr McKenna in the course of his remarks, said that the school needs more and better equipment in order to provide it with the means of coping with rival institutions in various parts of the world He hopes that in future the failure to make this provision will be remedied In a memorial from past students of the Royal School of Mines to a departmental committee which inquired into the formation of the new technological college three requests were made, namely – "(1) that the title be retained as 'The Royal School of Mines' (2) that the diploma of 'Associate of the Royal School of Mines be retained as heretofore (3) that the school even though it may be affiliated to some central institution be preserved as a separate entity as regards mining and metallurgical training with its own special staff and organisation" As an answer to these requests, Mr McKenna read a paragraph from a draft of a charter which may be issued hereafter The clause states that "One of the

departments of instruction of the new institution shall provide specialised courses in mining and metallurgy, and that department shall be called and known by the name of 'The Royal School of Mines,' and the governing body shall award the diploma of 'Associate of the Royal School of Mines' to any student who completes such courses to the satisfaction of the governing body." The individuality and history of the school will thus be preserved, and will not be sacrificed in what the chairman called a jumble. In conclusion, Mr McKenna expressed the hope that though in joining a larger association the school necessarily will sacrifice a certain amount of individuality as a governing body, nevertheless by retaining the name and the diploma it will be compensated for any respect in which it may suffer by the advantages which will accrue from the fuller and more complete equipment. The name and the fame of the Royal School of Mines must be kept bright as a star in the firmament of the new institution which is to be a pioneer even to Germany in the work of scientific training.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 13, 1906.—"An Examination of the Lighter Constituents of Air." By J. E. **Coates**. Communicated by Sir William Ramsay, F.R.S.

About 73,000 litres of air were systematically fractionated in order to ascertain whether any constituent lighter than hydrogen (e.g. coronium) were present. A preliminary concentration of the lighter portions was effected by collecting the gas which had passed repeatedly through an air-liquefying plant, precautions being taken to avoid contamination of the gas with hydrogen. By fractionation of the liquefied gas, a light portion having a volume of about 4700 c.c. was obtained, which was further fractionated by absorption in charcoal at about $-205°$ C. The lightest fractions thus obtained were examined spectroscopically, but no lines were detected which could not be attributed to hydrogen, helium, and neon. The volume of hydrogen amounted to 0.778 c.c., while the total volume of neon and helium obtained was 46 c.c. Assuming that 60,000 volumes of air contain one volume of mixed neon and helium, it appears that hydrogen is present in the air to the extent of one part in about a million and a half. This estimate has been subjected to a correction for the solubility of hydrogen in liquid air, an approximate correcting factor being obtained by performing the fractionations on a sample of air to which a known small quantity of hydrogen had been added. This is much smaller than previous estimates; it seems probable that hydrogen is a variable constituent of the atmosphere.

January 31.—"A Recording Calorimeter for Explosions." By Prof. Bertram **Hopkinson**. Communicated by Prof. H. L. Callendar, F.R.S.

This paper describes a method of recording the heat lost up to any instant after an explosion of coal-gas and air in a closed vessel. For this purpose the vessel, which was cylindrical and about 1 foot in diameter and 1 foot long, was lined first with a wooden backing $\frac{1}{2}$-inch thick and then with a continuous length of copper strip $\frac{1}{2}$-inch wide by 1/25 inch thick. The strip was wound helically on the cylindrical part of the vessel, and the two end-plates were covered with parallel pieces joined up at the ends so as to form an electrically continuous length.

The method consists in recording the rise of resistance of the whole length of copper strip when the explosion takes place. The rise of resistance is proportional to the rise of mean temperature of the strip. Hence, knowing the heat capacity of the copper, the total heat that has passed into it at any instant can be obtained from the record after making certain corrections for the heat which has passed from the copper into the backing and into those parts of the walls which are not protected by the copper.

The record of resistance was obtained by passing a known current (about 8 amperes) through the strip and recording the potential at the terminals of the strip by means of a reflecting galvanometer having a period of about 1/15th of a second. The galvanometer was placed in series with a constant source of E.M.F. of such magnitude as to balance the E.M.F. at the terminals of the strip when cold; the galvanometer deflection was then proportional to the rise of E.M.F. between the terminals of the strip, and so to the rise of resistance. The galvanometer mirror reflected an image of a fine hole illuminated by an arc lamp on to a photographic film carried on a revolving drum. A photographic record of the pressure in the vessel was obtained at the same time on the same film.

The mixture used consisted of one part of coal-gas and about seven parts of air at atmospheric pressure and temperature. It was fired by an electric spark at the centre of the vessel. To test the accuracy of the calorimeter, the heat which had passed into the walls at the end of one second from firing was calculated from the record, and was found to be 10,000 calories. The temperature of the gas at that moment was found from the pressure record to be 545° C. Using Holborn and Austin's values for the specific heats of the constituents up to that temperature, the heat remaining in the gas was calculated to be 3800 calories. The total heat accounted for by the calorimeter and pressure records is therefore 13,800 calories, and this should be equal to the heat of combustion of the coal-gas used. This was the case within 2 per cent.

The calorimeter record shows that during about two-fifths of a second after firing the rate of heat loss to the walls at any moment is approximately inversely proportional to the square root of the time. That is, the law of heat loss is initially the same as that of a solid at uniform temperature the boundary of which is suddenly cooled. It is pointed out that the rate of cooling is conditioned mainly by the state of the surface layer of gas in contact with the walls; at first heat is drawn from that layer, and the loss of heat is very rapid, but when the surface layer has been cooled down it acts as heat insulation for the remainder, and further cooling is relatively slow.

Linnean Society, February 21.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The Percy Sladen Trust Expedition to the Indian Ocean in 1905 under Mr. J. Stanley Gardiner: (1) Description of the expedition: (i.) Introduction, (ii.) history and equipment of the expedition, (iii.) *résumé* of the voyage and work. Part i., Colombo to Mauritius: J. Stanley **Gardiner** and C. Foster **Cooper**.—(2) Land nemerteans, with a note on the distribution of the group: R. C. **Punnett**. A single land nemertean obtained by Mr. Stanley Gardiner in the Seychelles must be referred to a new species, and has accordingly been named *Geonemertes arboricola*. The specific name has reference to the peculiar habitat of the worm, which occurs, among other places, in the leaf-bases of the screw-pine, *Pandanus hornei*.—(3) I and Crustacea: L. A. **Borradaile**. The collection contained thirty species, belonging to eleven genera. None were new to science, and all had previously been reported from the Indian Ocean. The fauna revealed by the collection is richer than that of the Maldives and Laccadives, but otherwise closely resembles it.—(4) Hymenoptera: P. **Cameron**. Thirty-two species of the group were obtained, ants being excepted. Of these seventeen are described as new, one *Tolbia scaevola* as the type of a new genus. Ten species were obtained from the Chagos, three being new, and twenty-three from the Seychelles, including Coetivy, eleven new, the fauna for this archipelago now consisting of twenty-four species. As regards the habits of the species, it is suggestive that so many of them belong to genera (Evania, Ampulex, Sphex, Notogonia, &c.) of which many, if not most, of the species prey on Orthoptera.—(5) Dragon-flies: F. F. **Laidlaw**. The collection contains fourteen species, none of which are new. All were obtained in the Seychelles, and four in the Chagos as well. It is suggested that the species peculiar to the Seychelles are a fragment of an endemic fauna, which is being displaced throughout the whole Indo-African region by an invading fauna from the north.—(6) Fourmis des Seychelles, Amirantes, Farquhar et Chagos, déterminées par H. A. **Forel**. Nous avons pour les divers groupes d'îles en question 8 espèces cosmopolites, 8 espèces malgaches,

8 formes locales, qui ont toutes dans leur dérivation un caractère malgache, trois formes locales (sous-espèces ou variétés) dérivées d'espèces indomalaises, une espèce océanienne, une espèce américaine évidemment importée et ayant un peu varié, puis deux formes communes aux archipels mais l'une au moins décidément dérivée malgache Enfin, une espèce (*Pheidole punctulata*) et une sous-espèce (*Camponotus grandidieri*) tout communes aux faunes africaine et malgache, probablement dérivées de la première —(7) Pycnogonida Prof G H **Carpenter.** Only five species of the group were obtained, of which four are described as new The most remarkable is a Colossendeis from 450 fathoms off the Saya de Malha Bank —(8) Aves Dr H F **Gadow,** F R S, and J Stanley **Gardiner** The birds obtained were in no way remarkable, being mostly waders or regular sea-birds of wide distribution The crab-plover (*Dromas ardeola*) was found everywhere Of economic importance as guano-formers were breeding colonies of *Fregata ariel* on Nelson Island, Chagos, *Sula piscator* on St Pierre, *Sterna fuliginosa* and *Anous leucocapillus* on Cargados Carajos, and *Pelecanus crispus* and *Puffinus tenuirostris* on St Joseph, Amirante Islands

Society of Chemical Industry, March 4 —Mr R J Friswell in the chair —Five years' experience in measuring and testing producer gas R **Threlfall,** F R S The first part of the paper is devoted to a *résumé* of the principles and construction of the instruments employed in Pitot tube gas measurement This is followed by a description of the "static" method of measuring gas density An account is then given of the results of balancing the make and distribution of producer gas over a period of several years this being illustrated by curves which show that an agreement within about 2 per cent can be attained in practice The next section of the paper is devoted to a discussion of the theory and practice of measuring pulsating streams of gas or air, such, for instance, as are produced by pumping by gas-engines or otherwise As to the question of sulphur in producer gas, it is shown that the referee's test is less suitable for this purpose than a modification of Valentine's test The discussion of this matter covers both the determination of sulphuretted hydrogen and of total sulphur, and it is shown that it is fatal to the sulphuretted hydrogen to employ a gas meter containing water—no matter how long it may have been in action The best methods hitherto proposed and practised for the determination of the volume of gas produced per ton of coal, otherwise than by the author's meters, are considered critically and some examples are given of the results of balancing on carbon and on ammonia The paper ends with a note on the determination of producer temperatures by a system of thermocouples which are read by a potentiometer suitably divided to read direct, and fed by a very large Clark or cadmium cell

Zoological Society, March 5 —Mr. F Gillett, vice president, in the chair —The discovery, in cave deposits in Crete, of remains of elephants, some of which represent a new species Miss D M A **Bate** —Report on the Polyzoa of the third Tanganyika expedition C F **Rousselet.** Five species were represented in the collection, three of which were described as new Of the five species, three belonged to the Phylactolæmata and two to the Gymnolæmata Amongst the latter was *Arachnoidia raylankesteri*, Moore, which was found in some abundance on shells dredged from deep water — Report on the Brachyurous Crustacea of the third Tanganyika expedition Dr W A **Cunnington.** The collection contained specimens from both Nyasa and Tanganyika Including a few individuals which had hitherto passed without notice in the collection of the British Museum, there were now on record three species from Nyasa and five from Tanganyika Of these species, three were described as new The forms from Nyasa all belonged to the widely distributed subgenus Potamonautes, but while two species from Tanganyika also belonged to that subgenus, the lake contained three species belonging to the remarkable endemic genus Platythelphusa, A Milne-Edwards The suggested marine appearance of *P armata* was considered to be only superficial, and the peculiar character of the Brachyuran fauna of Tanganyika could be explained on the grounds of a prolonged isolation of the lake —Two new species of African oligochæte worms of the genus Microchætus belonging to the collection of the Christiania Museum F E **Beddard.**

Physical Society, March 8 —Prof J Perry, F R S, president, in the chair —The rate of recovery of residual charge in electric condensers Prof F T **Trouton** and S **Russ.** The experiments described by the authors were undertaken in order to examine the rate of recovery of residual charge when the difference in potential of the plates is kept constant Previous experimenters have always allowed the charge to accumulate on the plates while observing the rate of rise in potential In that case the recovery meets with an ever-increasing opposition which complicates matters The authors have employed two methods In the first, which was used with mica condensers, the potential, observed by an electrometer, was kept constant by means of a variable resistance which was gradually increased as the recovery current diminished The high resistance necessary was constructed of two horizontal metal plates with ionised air between them A movable shutter could be introduced between the plates to diminish gradually the cross-section of the air resistance as required The second method was used when the residual charge was great enough In it the current was passed through a dead beat galvanometer, and the value of the recovery current at each moment determined In this case the difference of potential of the plates may be taken as constant since it was practically zero The observations when plotted with current against time were found to lie on a hyperbola This shows that in the circumstances of the experiments the quantity of electricity recovered up to any given time follows a law $Q = a \log(p+t)$ similar to that found by Rankine and others for the recovery of stress in overstrained elastic bodies when the strain is kept constant

MANCHESTER

Literary and Philosophical Society, February 12 —Mr Francis Nicholson in the chair —Some tables for explaining the nature of statistical correlation A D **Darbishire** The thirteen tables exhibited graphically the results of thirteen series of pairs of throws of dice in such a way that the effect of increasing the correlation between the first and second throws of the pair was clearly seen The method is an application, to some new sets of throws, of Weldon's beautiful device for illustrating statistical correlation

February 26 —Prof H B Dixon F R S in the chair —Report on the recent Foraminifera from the coast of the Island of Delos (Grecian Archipelago), part iv H **Sidebottom** Drawings of some of the more interesting species were exhibited and mounted specimens were shown under the microscope —The leaves of Passerina Madeline **Carson** The Passerinæ belong to the natural order Thymelæaceæ These plants inhabit the warm dry regions of Egypt, South Africa and the Mediterranean They are common on the sand hills near the coast, and always live under conditions in which there is a difficulty of obtaining water In order to combat against this, they are specially modified The leaf surface is reduced, often the leaves are imbricating They are provided with a very thick cuticle have the edges inrolled, and the stomates are found only on the inner surface They are further protected by a covering of hairs The chief object of the study of these leaves was to discover whether the epidermal cells contained mucilage or not In *Passerina filiformis* and in *P hirsuta* the author found that in many of the epidermal cells a portion was cut off from the rest by a cellulose wall The upper portion contained tannin and probably mucilaginous sap while the lower portion consisted of hard stratified mucilage In the other species examined *Passerina ericoides* and *P rigida* no trace was found of separation of the epidermal cells into a striated and non-striated portion The whole epidermal cell stained with mucilage stains and tannin stains Since mucilage and tannin both act in the same way towards methylene blue and since it is impossible to separate tannin and mucilage the evidence for the presence of mucilage in these species is not perfectly conclusive As however mucilage is with

out doubt found in some Passerinæ, its absence is not characteristic of the group and therefore its presence or absence can no longer be used as a basis for classification of the Thymelæaceæ

PARIS

Academy of Sciences, March 18—M A Chauveau in the chair A property of platinum amalgam H **Moissan** When platinum amalgam is shaken with water, a semi-solid mass of the consistency of butter is formed This appears to be permanent, since the volume does not change after keeping for one year, and the mass can be heated to 100° C without destroying it Amalgams of copper, silver or gold do not produce a similar emulsion, but separate in precisely the same fashion as pure mercury—The wax from the palm *Raphia Ruffia*, of Madagascar and on arachic alcohol A **Haller** An alcohol possessing the formula $C_{20}H_4O$ was isolated from this wax This is the same formula as that of an alcohol isolated by M Etard from lucerne but a comparison of the two showed that they were not identical The acetic and benzoic esters of the new alcohol were prepared and also a hydrocarbon by treating with anhydrous zinc chloride Arachic alcohol was also prepared and found to be not identical with the alcohol under examination—The existence of parameters capable of characterising the magmas of a family of eruptive rocks Michel **Lévy** Having a set of fifty analyses of rocks of the Mont-Doré series in which particular care had been given to the determination of the alumina and the separation of the alkalis the author has worked out a set of the various parameters to characterise rocks the most stable of all being that which represents the latent acidity,

$$\phi = \frac{S_{sal}}{2k + 3n},$$

where S_{sal} represents the silica of the white elements and $2k+3n$ a number sensibly proportional to the sum of the atomic weights of the alkalis The modifications introduced by the pathological state in the immediate destinations of the nitrogenous elements A **Chauveau**—Observations of the Giacobini comet (1907*a*) made with the large equatorial of the Observatory of Bordeaux Ernest **Esclangon** The comet had the appearance of a feeble nebulosity with a clearly defined nucleus The apparent positions of the comet and mean positions of the comparison stars are given for March 12 and 13—Observations of the Giacobini comet (1907*a*) made at the Observatory of Algiers with the 31·8 cm *coudé* equatorial MM **Rambaud** and **Sy** Similar observations made on March 11 13 and 14 The comet appeared to be circular, with a diameter of about one minute of arc The central condensation was 5″ diameter, with a brightness corresponding to a star of the 11·5 magnitude—Elements of the Giacobini comet (1907*a*) Paul **Brück** Observations of the Giacobini comet (1907*a*) made with the *coudé* equatorial at the Observatory of Besançon P **Chofardet.** Similar observations for March 12, 14, and 16—The new Giacobini comet M **Giacobini**—Orthogonal systems of functions Frédéric **Riesz** Periodic solutions of linear differential equations T **Lalesco**—The problem of Dirichlet H **Lebesgue**—A surface of the sixth order related to Abelian functions of the third genus L **Remy**—Helices considered as generators of a surface G **Barré.**—The method of isoperimeters G **Hilleret.** An application of the method of isoperimeters to the rapid approximation of π—Aeroplanes A **Étévé**—Waves of shock and of spherical combustion M **Jouguet.**—The origin of spectra in series W **Ritz** It is known that the frequencies ν of the ordinary spectrum of hydrogen and of the new spectrum discovered by Pickering in certain stars are given very exactly by the formulæ

$$\nu = N\left(\frac{1}{4} - \frac{1}{m^2}\right) \quad \nu = N\left[\frac{1}{4} - \frac{1}{\left(m-\frac{1}{2}\right)^2}\right], \quad (m=3, 4, 5, \ldots),$$

where N is a constant An outline of a physical system is here given which it is shown would give rise to just such a system of vibrations—The ionisation of the chromium sulphates Albert **Colson** In the chromium sulphates the lowering of the freezing point appears to be independent of the ionisation as measured by the electrical conductivity—The alloys of nickel and tin Em **Vigouroux** By directly heating together pure tin and nickel alloys containing respectively 73·6, 83·6, and 92·7 per cent of tin have been prepared All three alloys are non-magnetic, and under the action of nitric acid leave a crystallised metallic residue—The arsenites and arsenates of rubidium A **Bouchonnet.**—The action of *p*-*p* tetramethyldiaminobenzhydrol on some methylene derivatives R **Fosse** The inequality of the resistance of natural starch and artificial amylose towards extract of barley J **Wolff** and A **Fernbach.** Amylose in its natural form is distinguished from artificial amylose by a much greater resistance to saccharification by extract of barley—The influence of fertilisation on the characters of figs Leclerc **du Sablon** Fertilisation which is not necessary in the varieties cultivated in France is possible, and increases both the weight and the yield The development of the *pneumathodes* of the palm and on the true nature of these organs C I **Gatin**—The mode of action of tephrosin M **Hanriot.**—Some consequences of the interpolation of the principal experiments of M Chauveau on muscular energetics Charles **Henry**—Morphological changes in the nerve cells surviving the transplantation of nerve ganglia G **Marinesco** and J **Minea.**—Locomotion in the Gasteropods Raphael **Dubois** and Fred **Vlès**—A new subfossil Lemurian of Madagascar G **Grandidier**—Some seismic constants deduced from the earthquake of April 4 1904 J **Oddone**

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THURSDAY, APRIL 4, 1907

CHEMICAL CRYSTALLOGRAPHY

Chemische Krystallographie. By P. Groth. Erster Teil. Pp. viii+626. (Leipzig: W. Engelmann, 1906.) Price 20 marks.

THE appearance of the first volume of this monumental work by Prof. P. von Groth marks an epoch in the history of crystallography. Ever since it was known that the famous editor of the *Zeitschrift für Krystallographie* had such a work in progress, expectancy has been of the keenest in the mineralogical and crystallographical world. That the book would be worthy of the man was felt to be assured, and the event has fully justified such confidence. It is to be published in four volumes, and if the other three are equal to the first now before us, the whole will form a compendium of crystallographic knowledge which for completeness, detail, and accuracy will stand unique. The work will include practically the whole of our crystallographic knowledge concerning every crystallised substance yet described.

There can be no doubt that Prof. von Groth is particularly marked out by circumstances for the compilation of such a *magnum opus*. For not only has he edited the *Zeitschrift für Krystallographie* since its inception by him thirty years ago, but he has exhibited from time to time, especially by the rapid succession of new editions of his standard text-book, "Physikalische Krystallographie," and his smaller but not less interesting "Einleitung in der chemische Krystallographie," a remarkable gift of assimilating, weighing, collating, and presenting in readable and indeed highly interesting form the chief advances in crystallography as they occur. His most careful personal editorship of every paper of importance which is published in the *Zeitschrift* has rendered him familiar with these advances in all their details. Moreover, his reputation as a teacher has made his laboratory at Munich the resort of as earnest and enthusiastic a class of students as is to be found anywhere. Hence this book will be received by all those interested in crystallography with a quite unusually warm welcome, deeply tinged with reverence, partly on account of the excellence of the material which the book itself contains, but in even greater measure because of the respect with which every word uttered by the great master and universally acknowledged *doyen* of his subject is received.

In Britain the book will meet with an exceptionally cordial reception from the small band of our native crystallographers, who have ever been treated by Prof. von Groth with particular kindliness, and have received from him the strongest encouragement, and never more so than at times when it has unfortunately been only too evident that the study of crystals was not appreciated in this country. The writer of this review can never forget the more than kind encouragement extended to him by Prof. von Groth during the earlier stages of the organised series of researches which the writer inaugurated in the year 1891 on the alkali sulphates and selenates and their double salts, and which had for their first object the introduction of greater accuracy into crystallographic methods. Prof. von Groth has frequently expressed the wish that the country of Miller, the father of modern crystallography, should take a much greater part in the advance of crystallography than she was doing some fifteen years ago. Now, however, at last the small band of British workers, partly from the stimulating influence of such encouragement, has been able to make some impression, and not only mineralogists, who have alone in the past appreciated crystallography at its true value, but chemists, to whom its intrinsic value is immeasurable, as well as metallurgists and physicists, are awakening to the fact that the study of crystals is the study of solid matter in its highest, most perfectly organised form, and that it is likely to lead to the most important fundamental truths. Already the researches just alluded to have afforded a final and irrefragable proof of the accuracy of Haüy's original conception that to every definite chemical substance there appertains a distinct and characteristic crystalline form, and have reconciled this with Mitscherlich's discoveries in isomorphism by revealing an exquisitely beautiful relationship, connecting very small angular differences which are found to occur between the crystals of the various members of isomorphous series with the atomic weight of the interchangeable elements composing them. This generalisation not only defines the real meaning, extent, and scope of Mitscherlich's law, but also proves that the supposed exceptions are not such, and therefore the absolute truth of the rule that difference of chemical composition does in all cases involve difference of crystalline form.

That the subject to the advance of which Prof. von Groth has devoted himself is indeed of the intrinsic importance which the writer has recently claimed for it, in a couple of articles in the engineering supplement of the *Times*, is strikingly demonstrated by the fact that the very groundwork of chemistry, the law of valency, has been shown in a remarkable paper by Prof. Pope and Mr. Barlow, read recently to a crowded audience at the Chemical Society, to be clearly connected with, if not dependent upon, the internal structure of crystals. This most interesting theory carries the conception of "topic axes," which express the relative structural dimensions of the crystals of isomorphous series, and which were introduced simultaneously by Dr. (now Prof.) Muthmann, one of Prof. von Groth's pupils and assistants, and the writer in the year 1894, a step further so as to include no longer merely the members of isomorphous series, but also substances of the most diverse characters, and whatever may be the fate of this theory it can no longer be doubted that crystallography must play a much more important *rôle* among the subjects of science in the future than it has played in the past.

The present juncture, therefore, is a most opportune one for the appearance of Prof. von Groth's great book. It will be invaluable to all crystallographical investigators, and particularly so as an excellent bibliography of all the important investigations up to date

is included concerning every substance discussed. This first volume deals with the solid elements, with the inorganic compounds of a non-saline character, such as oxides, sulphides, and phosphides, and with the halogen salts, cyanides, and salts of the recently discovered nitrogen acids. The second volume is to deal with the inorganic oxy- and sulpho-salts and the remaining inorganic crystalline compounds, while the third and fourth volumes are to treat of the organic compounds. The arrangement of the text is that each group is described as regards its general characteristics in an introductory statement in large type, and this is then followed by the detailed description of each member of the group in smaller type.

An excellent *résumé* of the crystallography of the naturally occurring minerals is given, but it is the detailed crystallography of the substances requiring to be prepared chemically, and the descriptions of which cannot be found elsewhere except by reference to the widely scattered original memoirs, that renders the book so priceless, for it presents the essential results of all chemico-crystallographical investigations right up to date. The illustrative figures of crystals are neat and clear, and the text easy, the large type even luxurious, to read.

One important feature has been left to the last to refer to, namely, that the symmetry of the crystals of each substance dealt with is given in accordance with the much more scientific method of classification recently adopted as the outcome of the completion by Schönflies, Fedorow, and Barlow of the geometrical theory of homogeneous structures, which enables the particular individual class represented in the substance under discussion to be at once identified from among the thirty-two possible classes of crystal symmetry.

In conclusion, with regard to the contents of this book, the best of all possible praise can conscientiously be bestowed in saying that it is worthy of the master-mind that conceived it.

A. E. H. Tutton.

A NEW WORK ON ORGANIC EVOLUTION.

The Analysis of Racial Descent in Animals. By T. H. Montgomery, jun. Pp. xi+311. (New York: Henry Holt and Company; London: George Bell and Sons, 1906.) Price 10s. 6d. net.

IT would be a most fascinating task to trace the evolution of modern methods of dealing with the problems of life. Differentiation has taken place so extraordinarily quickly. The time is long past when one man can attempt to grapple with the whole problem. Not only so, but the time seems to be past when one man can even be interested in the whole problem. Evolutionists may be broadly classified into those to whom the problem of evolution is the problem of the origin of species and those to whom it is the problem of adaptation. The key-note of de Vries's "Mutationstheorie" is the solution of the problem of species; we even go so far as to say that this is the achievement of de Vries's work. The logical conclusion, the complete working out of the theory of natural selection, is reached in Dr. Archdall Reid's "Principles of Heredity." The interest of the two authors is entirely different. De Vries's interest is in the origin of species, Dr. Reid's in natural selection. Darwin's interest was in both; if we look no further than the title of his chief work we can see this—"On the Origin of Species by Means of Natural Selection."

The fact that these two interests have segregated, and the way in which they have segregated are both very suggestive, and the direction in which they point is the same. The fact of segregation suggests that the association of the two ideas was unnatural, and that they were not capable of union. The way in which they have segregated confirms this suspicion. For those who devote their attention to the question of species reject natural selection, while those who elaborate the theory of natural selection find no support in the phenomenon of specific difference. All possibility of a reconcilement between the divorced ideas is put an end to by Meyrick, who probably knows more about specific difference than anyone else. In his handbook of British Lepidoptera he says that, in seeking for the most suitable characters by which species may be distinguished, those which can in any way be regarded as useful to the species must be discarded without more ado.

It is not surprising that Darwin's work should have borne fruit which segregated in this way. The case is thoroughly Mendelian. Darwin's work was a cross between a biological theory of evolution and a social and industrial theory of competition. The hybrid, more vigorous than either parent, took the world by storm. We are now witnessing its posterity separating out more or less simply into the two forms which were united in the beginning. Just as every plant in the F_1 generation contains yellow and green peas, and just as it is not until the next that there can be found plants bearing only yellows or only greens, so Darwin's interest was in the "Origin of Species by Natural Selection," while now we find de Vries, who is absorbed entirely with the former, and Reid entirely with the latter.

The immediate result of Darwin's work was the flood of energy which spent itself in tracing out the genealogical histories of organisms. To such lengths did the students of phylogeny go, so remote from reality did their speculations become, that the study of phylogeny has fallen into discredit in the eyes of a great many of those who are looked up to as biological thinkers to-day.

Prof. Montgomery's interest is centred neither in species nor in selection, but in phylogeny. He admits that phylogeny has been discredited by the indiscretion and shallowness of a number of its exponents, but he contends that if we limit ourselves to the strictly experimental method we are neglecting an enormous range of phenomena.

"For living organisms are in number and variety hardly commensurate with the vast assemblage of their ancestors. Are we then to leave out of consideration all this once existing life, simply because

its units are no longer subject to experiment? Most assuredly not"

Our author undertakes the herculean task, we venture to think successfully, of setting the study of phylogeny on a surer foundation The reason that phylogenetic inquiry has become discredited is that the majority of biologists are neither so stupid that they are content to dabble with phylogeny nor clever enough to make it a great and fruitful sphere of inquiry—a field fit for the exercise of the highest intelligence

The experimental method has its limitations no less than its fascination It is not merely a paradox to say that in biology those things with which we can experiment most are those which to the organism matter least The reason is that we are not the first to start experimenting Nature has been there before For example, the range of continuous variation in an organism may either be the direct result of the constitution of the living substance or it may have been determined by the most stringent selection acting since life dawned If, therefore we institute experiments on variation—for example the determination of the effect of heat on the range of variation—we may either be studying one of the simple properties of protoplasm or discovering the limits within which natural selection allows the particular organism dealt with to vary under the conditions of heat, *e g*, to which we subject it The really fundamental processes do not lend themselves to experiment That is how they have become fundamental Everyone who wishes to train himself to study them should read Prof Montgomery's book

There are a few trifling misprints, *e g* "embryoning" in the table of contents, and Mendel worked not with the sweet, but with the culinary pea

A D D

ELECTRIC RAILWAYS

Electric Railway Engineering By H F Parshall and H M Hobart Pp xxiv+475 (London Archibald Constable and Co Ltd 1907) Price 42s net

THE authors of this work have already introduced a series of technical works upon dynamo design and kindred subjects and Mr Hobart is also known as the author of a recent work upon the steam turbine

In the present volume the authors deal with a wider range of subjects, and, in short, treat of the whole question of heavy "electric traction," that is traction as applied to railways rather than to street tramways Such a book was required, and will be welcomed by the growing class of engineers who wish to add to their experience of steam railway work some knowledge of electrical engineering, which is more and more coming to invade the field of traction

Technical works of this kind may, as a rule, be divided into two classes, on the one hand are the highly technical works which deal with the more scientific aspects of the subject, and of which the authors' "Dynamo Design" is an example, on the other are the entirely practical works which, at their worst, degenerate into collections of specifications The present volume endeavours, not unsuccessfully to combine these two, and to give the reader a clear knowledge of the fundamental principles that underlie the application of electricity to haulage, illustrations of the methods employed in carrying this into effect, and actual examples and details of construction What it does not fully supply, and what unfortunately, books of this kind very seldom contain, are the commercial results obtained from the adoption of electric traction It may be said that this is outside the scope of an engineering treatise, and if the work is to comprise engineering in the sense in which that word was commonly used during the last century the answer is justified, for the engineer of those days was concerned with the question of "will it work?" rather than the question of "will it pay?" But the engineer of the twentieth century has become more and more obliged to look upon the latter as the test of successful engineering, and until a book can be produced dealing with electric traction from the operating point of view such works will not, it is to be feared, have much effect in influencing railway authorities to replace steam haulage by electric traction Apart from these limitations however, the present volume is most valuable for although a considerable portion of the matter has been already published in one form or another, there was a great need for bringing together all that has been done and written

The choice of the system to be adopted upon any particular part of a railway, although necessarily influenced by first cost, should ultimately be dependent upon its suitability for use upon the railway as a whole, and the results obtained from electrification must be judged in reference to the whole railway undertaking rather than in connection with one section In connection with the vexed question of the relative advantages of direct current, single phase or three phase, the authors do not undertake to predict the form that the ultimate electric railway installation will assume, contenting themselves with pointing out the merits of each, and emphasising the fact that standardisation has been one of the great elements of success in steam railway working, and that the adoption of electric traction upon railways in the future will be slow until standardisation is adopted

Coming now to the contents of the book itself it consists of three parts, dealing respectively with the mechanics of electric traction, the generation and transmission of the electrical energy and the rolling stock Chapter i deals with "tractive resistance at constant speed," and gives the results of applying both theoretical and arbitrary formulæ to the result obtained in actual practice

Chapter ii deals in a similar manner with the problem of acceleration Many useful curves of acceleration, speed-time, and speed-distance are given Chapter iii deals with tractive force in relation to acceleration, while chapter iv deals with the

characteristics of railway motors, upon the design of which Mr. Hobart is an acknowledged authority. Throughout the whole of this section a liberal use is made of graphical methods, and a number of curves referring to the energy consumption under different conditions in actual practice is given.

Chapter v. deals with the generating plant, and is, in our opinion, so far as the practical value of the information contained is concerned, scarcely so useful as the rest of the book; considerable space is devoted to descriptions of tramway generating stations, which, however up to date at the time of construction, are hardly representative of the most modern practice. The question of power-station design is a subject of its own, and is not one upon which the railway engineer, pure and simple, is often called upon to express an opinion. A design is given, however, of a proposed 10,000-kilowatt station, but so far as can be judged from the drawing the "complete unit" system by which, for safety reasons, the plant and buildings are entirely subdivided does not appear to be recommended. Interesting tables of the comparative cost and annual over all efficiencies of various generating stations are given.

A chapter upon the transmission of the electrical energy calls for no particular comment; sections of the cables adopted on various railway systems and the sizes of such cables are given. Particulars are also given of the cost of these cables, but the value of this is, of course, greatly dependent upon the price of copper. Substations are next dealt with, details being given of a very large number of actual substations used in railway work.

Chapter viii., dealing with the distributing system, in other words the third rail, is of more interest, and contains a number of tables dealing with recent practice in this connection; overhead work is also illustrated, though not so fully as could be wished.

Part iii. deals with rolling-stock, and is replete with illustrations and working drawings of locomotives and carriages. This portion of the book, however, shows signs of haste in editing, and in future editions we would suggest that the efficiency curves of motors which it contains, and, in fact, the reference to motors generally, should be gathered together in one section, namely, chapter iv., where most of them are already to be found, instead of being again dealt with under locomotives; certain of the data of rolling stock given in chapter iv. would, in our opinion, be more easily found in the chapter which is specially devoted to that branch.

These are, however, minor criticisms. The work is one of great practical value to all railway engineers, and will be further enhanced if in future editions more actual illustrations of the total costs of operation of electrified steam railways can be furnished. The North-Eastern Railway, the Lancashire and Yorkshire, and the District Railways have all been in operation long enough to furnish data of the greatest commercial value.

The general "get up" of the work is excellent, as are the reproductions of the various drawings.

OUR BOOK SHELF.

L'Année technique, 1906. By A. Da Cunha. Pp. xii+237; illustrated. (Paris: Gauthier-Villars, 1906.) Price 3.50 francs.

Since 1901 the author has each year prepared in attractive form a concise summary of recent progress in engineering, and his series of volumes cannot fail to prove of inestimable value to the student of French industrial history. His annual summary is not a mere compilation of disconnected notes, but a collection of essays written with originality, technical knowledge, and literary skill.

The subjects dealt with in the record for 1906 comprise accidents in works, the heating and water-supply of houses, public works, and locomotion. A museum illustrating the prevention of accidents in works having recently been inaugurated at the Conservatoire National des Arts et Métiers, Paris, the author has seized the opportunity of dealing at some length with the subject of industrial hygiene, and describes the museums that have been established with the object of bringing to public notice the arrangements that have been found by experience adapted for the protection of workmen in various industries. Museums of this kind exist at Zurich, Amsterdam, Vienna, Munich, Berlin, and Paris. The problem of efficaciously heating dwelling-houses is one that has long been under consideration. The old French fireplace, in which, it has been said, the hottest place is at the roof, has been superseded by modern fireplaces, by fixed or movable stoves, and by heating with steam or hot water.

Many ingenious improvements are described by the author, who also gives some useful advice on this important topic. Other interesting subjects dealt with include the installation of the huge compressed-air caissons for the passage of the Paris Metropolitan Railway under the Seine, the recent developments in automobile transport, and locomotion on ice and snow. The numerous illustrations have been carefully chosen and well executed, and the volume is produced in an attractive style at a modest price. Mr. Alfred Picard contributes a preface, which, like the rest of the volume, may be studied with profit and pleasure not only by the engineer, but also by the general reader desirous of acquainting himself with the events of the day.

Diseases of Fruit and Fruit-bearing Plants. (Board of Agriculture and Fisheries.) Seven diagrams and text. (London: Printed for H.M. Stationery Office by Darling and Son.)

The Board of Agriculture and Fisheries has issued a series of seven small coloured diagrams illustrative of a number of common diseases met with in cultivated plants, especially those which are grown for the sake of their fruit. They are adapted for use in schools in the country districts. They illustrate the general appearance of the diseased fruits, without any botanical details. Indications are given as to the best methods of prevention. The use of Bordeaux mixture is frequently and judiciously recommended, but no instructions are given as to the way in which the mixture should be prepared. It is certain that, in spite of the publicity which has been given to this excellent fungicide, many cultivators do not yet know how to prepare it. The use of liver of sulphur is also recommended, but the caution is not added that it should not be allowed to come in contact with the paint on frame or greenhouse, so as to prevent the discoloration that would otherwise ensue.

No attempt is made to indicate the degree of injury inflicted by various fungi; thus the first of the series, the "strawberry leaf-spot," is of very little conse-

quence as compared with No 2, the strawberry mildew The now famous American gooseberry disease is illustrated To prevent its spread, the use of one ounce of potassium sulphide dissolved in three gallons of water is recommended With this solution the bushes should be sprayed just before the leaves expand, and the spraying should be repeated at intervals as necessary It is unfortunate, we think, that the destruction of affected bushes by fire is not also recommended A descriptive pamphlet, for which one penny is asked, is supplied with the diagrams

La Mécanique des Phénomenes fondée sur les Analogies By M M Petrovitch (Belgrade) "Scientia" Phys-Math Series, No 27 Pp 96 (Paris Gauthier Villars, 1906) Price 2 francs

DR J W MELLOR, in his 'Chemical Statics and Dynamics," p 19, gives the following as the four stages of a physical theory —hypothesis, differential equation, integration, observation While this sequence is well illustrated in the study of dynamical phenomena, these, after all, constitute but a small proportion of the large number of effects in which changes are brought about by the action of definite causes This book while not containing any very novel and striking features, puts matters in a somewhat fresh light by giving prominence to the more philosophical aspect of the equations of mathematical physics and allied branches of science Thus the motions determined by a constant force, a positive, and a negative force varying as the distance, are all characterised by different known forms of the integrals of the equations of motion If in any phenomenon the changes which occur can be represented by equations of the form of one of these integrals then conversely the relation between cause and effect may be of the same form as the corresponding law of force The mathematical portion of the book is comparatively simple and about the hardest problem considered is that of forced oscillations in a resisting medium The book appears suitable for placing in the hands of such science students as have not the time to pursue an extended course in mathematics as they would doubtless get many hints from its perusal It may be doubted whether much is gained by the inclusion of physiological problems, such as the action of bacteria in the present discussion or whether such problems can indeed be adequately treated without introducing statistical considerations But there are many cases where, even if the analogy be not exact, it is more easy to picture the progress of phenomena by associating them with dynamical or other analogues, and the book will be useful if it teaches students to think in this way

The Steam-table A Table of the Thermal and Physical Properties of Saturated Steam Vapor and of the Specific Heat of Water Compiled from various sources by Prof Sidney A Reeve Pp ii+42 (New York The Macmillan Company, (London Macmillan and Co, Ltd) Price 1s 6d net

THIS is a very elaborate table from 400 lb per sq inch and 445° F down to 0·18 lb per sq inch and 32° F Usually we know a pressure in round numbers or a temperature in round numbers and two separate tables are needed, Mr Reeve's table contains both, and there is an ingenious arrangement for making interpolation easy There are entries for every degree and also for every pound per sq inch The usual error of such tables, using Regnault's heats with a value of Joule's equivalent which does not agree with Regnault's unit of heat seems to be avoided by Mr Reeve and this steam-table seems to us likely to prove of very great value to steam engineers

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications]*

Ionisation by Spraying

IN a paper published in the *Philosophical Magazine* (February) I noted that positive and negative ions could be observed in large quantities by an Ebert apparatus if fine spray from water were produced profusely in its neighbourhood Whilst much work has been done in connection with electrification caused by the bubbling of air through water and the splashing of drops, the effects due to spray do not appear to have received much attention

A description of a simple method of studying the ionisation by spraying, with a preliminary note of some of the results obtained, may therefore be of some interest A strong current of air, filtered through cotton wool, is passed for a definite time usually half a minute, through a small glass sprayer as supplied by Beckmann for introducing salts into a flame for spectroscopic work but in the present case the air and spray pass together into the large lower chamber of an electroscope containing an insulated cylinder connected with a gold-leaf system in a small upper chamber The leaf remains steady when air alone is driven into the lower chamber, except for a slight natural leak which remains constant in spite of much spraying

When spray has been introduced into the electroscope for half a minute the fall of potential is observed for that time, and from minute to minute until the leaf steadies to the natural leak The effect terminates in two or three minutes in the case of water but in the case of acetic acid, chloroform ether and the alcohols the ionisation effects do not disappear for ten to fifteen minutes, so that there are large inert ions, both positive and negative, present, some with a velocity of the order 10^{-4} cm sec in a field of 1 volt/cm Similar results have been found by Aselmann for salt solution

In most cases the positive and negative ions are generated in nearly equal quantities, but with water the negative ions are about 1·5 times as numerous as the positive The same ratio holds for ether of which the negative ions are more quickly removed than the positive The most important point, however is that small quantities of liquids can be examined by the help of these small sprayers and definite results obtained for the substances, if care is taken to avoid impurities

The following is a preliminary statement of the results obtained

Substances	Negative	Positive
Mercury	0	0
Toluene	0·02	0·02
Sea-salt and water	0·01	0·015
Hydrochloric acid and water	0·04	0·04
Pentane	0·07	0·03
Phenetol	0·08	0·08
Benzine	0·14	0·08
Ammonia water	0·45	0·30
Tap water	0·65	0·50
Distilled water	1·7	1·0
Ether	3·7	2·5
Chloroform, pure	2·3	2·3
Chloroform impure	4·5	4·5
Acetic acid	3·2	3·2
Methyl iodide	3·0	3·0
Methyl alcohol	3·0	3·0
Ethyl alcohol	3·5	3·5
Amyl alcohol	4·5	4·5

The figures are taken to an arbitrary standard and are expressed in terms of the positive ionisation due to distilled water It may be better ultimately to select ethyl alcohol as a standard of comparison, because the ionisation due to water varies sharply when any impurity is introduced

It is remarkable that volatile substances like benzine pentane phenetol and toluene should give rise to little or no ionisation when sprayed, whilst ether chloroform alcohol and aldehyde should so profusely form both positive and negative ions

A S EVE

McGill University, March 22

On the Extinct Emeu of the Small Islands off the South Coast of Australia and probably Tasmania

SOME of my colleagues in Australia, as I gather from "Notes" in NATURE (vol. lxxv., pp. 228, 467) have lately been at work on the identification of the small emeu of the islands in Bass Strait and Tasmania now extinct. Prof. Baldwin Spencer, of Melbourne, having examined the bones of the emeu which once lived on King Island and found them smaller than those of *Dromaeus ater* of Kangaroo Island, has felt justified in proposing a name for that bird, and has called it *D. minor*. Colonel Legge, an old colonist, has also been working on the King Island emeu, and proposed for it a name which, however, he withdrew in a postscript to his paper in favour of Prof. Spencer's one already published. From memory, having seen a pair in his boyhood, Colonel Legge considers the Tasmanian emeu a distinct *small* species.

Now I believe that the question of the emeus of small size which about a century ago yet lived in Tasmania and on the small islands off the south coast of Australia can only be settled by a careful comparison of their bones, and then and then only shall we know whether one or more species lived on those islands. I do not know of the existence in museums of specimens, either mounted skins or skeletons, of well authenticated Tasmanian emeus, but we possess two authentic skeletons and two mounted specimens of *Dromaeus ater* (Peron), which in the first years of last century was abundant on Kangaroo Island; two of these four specimens are in Paris, one is in Florence, and one in Liverpool. Mine is a skeleton, and is one of the three brought alive to France by Peron in 1803 from l'Ile Decrès (Kangaroo Island) (NATURE, vol. lxii., p. 102; *Ibis*, 1901, p. 1); the Liverpool specimen is, I think, not located; it is undoubtedly *D. ater*, but might hail from King Island or even from Tasmania; it may be the lost "lesser emea" of the Bullock Museum, dispersed in 1819.

I may now add that last summer my friend Mr. Alexander Morton, director of the Tasmanian Museum at Hobart, sent me some bones of the small emeu which he had collected on King Island in Bass Strait, asking me to compare them with the corresponding bones of the skeleton of *D. ater* in this museum. I did so at once, aided by Prof. E. Regàlia, a high authority on ornithic osteology; the result of our careful comparison was that, barring some slight differences of purely individual value, the remains of the three specimens from King Island examined *were absolutely identical* with the corresponding bones of Peron's specimen from Kangaroo Island. I therefore wrote to Mr. Morton (from whom I have not heard since) that I had not the slightest doubt that *D. ater* (Peron) once lived on King Island, and unless new evidence should show the contrary, I am much inclined to favour the hypothesis that the same diminutive emeu once lived in Tasmania. HENRY H. GIGLIOLI.

Royal Zoological Museum, Florence, March 20.

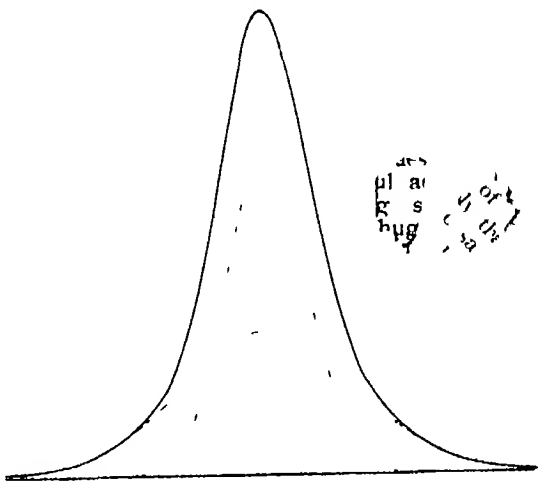
Mean or Median.

THE two applications of the *median* suggested in Mr. Galton's letter (NATURE, February 28) and his article (March 7) respectively, seem to me to be somewhat distinct.

In the case of a jury or committee voting as to a sum of money to be given there is no question of truth, but only of expediency. If any amount be proposed and put to the vote, the proposition will (by the ordinary way of voting) be defeated so long as that amount is above the median; the process of voting tends therefore to give an amount *not greater than* the median. Mr. Galton's suggested procedure is in this case, it seems to me, quite correct, and a saving of time would be effected if the problem were consciously approached from his standpoint.

The case of averaging a series of estimates with the view of arriving at objective truth appears to be on a different footing. If there is a considerable sprinkling of fools or knaves amongst the estimators, or of persons with a tendency to bias—as the buyers and sellers might be in judging the weight of cattle according to the suggestion of Mr. Hooker—the question as to choice of means is one that is difficult to answer. The important question is, in fact, not the "probable error," but the probable *bias*, for the whole frequency distribution may centre round an entirely erroneous value. If, on the other hand, the observers are honest and unbiassed, the choice of average turns on the form of the frequency distribution; we require that average which is (1) least erroneous, as a rule, (2) least subject to fluctuations of sampling—two conditions which may very well conflict. As regards (1), psychologists, following Fechner, suggest the geometric mean, I believe, as the best. But the distribution of guesses given by Mr. Galton does not appear to follow the law of the geometric mean; if it did, the median should be less, not greater, than the arithmetic mean. Further, so far as one can judge, the geometric mean would give a value as much too low as the median is too high. Looking at the distributions in Prof. Pearson's memoir on errors of judgment (Phil. Trans., 1902), there seems very little to choose between the mean, the median, and the mode; sometimes one is the best and sometimes another.

As regards (2), the probable error of the median has been discussed on several occasions by Prof. Edgeworth (*Phil. Mag.*, 1886, 1887; Camb. Phil. Trans., xiv., 1885). The value is $0.674 \ldots / 2h\sqrt{n}$, where h is the true ordinate of the frequency distribution at the median, i.e. $1/\sqrt{2\pi}\,\sigma$ for the normal curve. For the normal distribution, therefore, the probable error of the median is greater than that of the mean in the ratio of 1.25 : 1 approximately.



For a flatter topped curve with more curtate tails the ratio of probable errors is greater than 1.25 : 1, and accordingly for all such distributions the arithmetic mean is the better form of average. But for a curve with a high central peak and long tails the probable error of the median may be less than that of the mean, and it will be the more stable form of average. As an illustration Prof. Edgeworth has taken the case of a distribution compounded of two superposed normal curves with the same means and numbers of observations; if the standard deviation of the one is to that of the other in ratio greater than 2.236 : 1, the median has a lower probable error than the mean. The figure shows the critical distribution for which the probable errors of mean and median are the same.

In the absence of definite knowledge as to the frequency distribution of estimates in any specific case, it does not seem to me that any confident judgment as to choice of means can be given. G. UDNY YULE.

March 26.

Golden Carp attacked by a Toad.

THE following account of a toad attacking a golden carp may be of interest to some of your readers from its bearing on an ancient belief that frogs and toads are at enmity with carp, and kill them by destroying their eyes. Izaak Walton in the "Compleat Angler" refers to this belief,

and states that frogs attack carp by "sticking fast" to their heads. Possibly naturalists, unknown to me, may have already thrown light on the origin of a tale which hitherto I have regarded as a fisherman's story of the conventional type.

On March 29 my son directed my attention to a large golden carp (*C. auratus*) lying in shallow water near the edge of a pond in my garden with a frog or toad apparently resting on its head. The fish appeared to be very sluggish and made no attempt to escape from a landing net with which it was easily brought to shore. On examination it was found that the head of the fish was held tightly by a medium-sized common toad (*Bufo vulgaris*) which had obtained a very firm grasp by inserting its fore limbs as far as the second or elbow joint into the sockets of the eyes of the unfortunate fish. The ghoulish looking toad lay on the top of the fish's head facing its tail, and with its hind legs hanging in front of the fish's mouth. At first the appearance of the eyes of the fish led me to think they had been ruptured, but closer examination showed they were merely displaced and turned partially round owing to the pressure exerted by the intrusion of the toad's limbs between the eyes and their sockets.

On carefully withdrawing the toad's fore limbs, which were inserted to the extent of about 1 inch within the eye sockets, the eyes returned to their normal position apparently uninjured, but during their displacement the fish must have been quite blind. No effort of the fish could have rid itself of the toad after it had once obtained the remarkably firm grasp which has been described, and it appears very probable that the fish would have died in a short time. How the toad in the first instance obtained a hold in the sockets of the fish's eyes appears very puzzling, but a probable reason for its attempt to obtain a grasp, and for it holding on when a grasp was obtained, may perhaps be found in the unreasoning instinct which toads appear to possess at spawning time of grasping something firmly with their fore limbs. A few years ago in the same pond referred to above I found a toad embracing a water-logged puff-ball so firmly that it required considerable force to release the fungus from the amphibian's grasp.

ADRIAN J. BROWN.

Birmingham University, April 2.

The Atomic Weight of Nickel.

IN a recent number of NATURE (February 14, p. 367) Dr. Barkla gave reasons, based on experiments in connection with secondary Röntgen radiation, for assigning to nickel a new atomic weight. Dr. Barkla studies the penetrating power of secondary Röntgen radiation, shows that it depends on the atomic weight of the element, and from the values found for nickel in comparison with those found for copper and iron, he argues that nickel appears to have the atomic weight of 61.3 instead of the usually accepted value of 58.7.

Prof. McClelland (Trans. Roy. Dub. Soc., vol. ix., part i., 1905) showed that the intensity of secondary β radiation from different elements for the same exciting primary β rays depended on the atomic weight, and that a small difference in atomic weight could be detected in this way. According to Dr. Barkla, nickel has an atomic weight somewhat greater than cobalt, instead of the value slightly less, given by chemists. If this were so the intensity of the secondary β radiation from nickel should exceed that from cobalt.

I have recently repeated the observations of Prof. McClelland, using a very sensitive apparatus. Cobalt and nickel gave practically the same secondary radiation; if there is any difference, that given by cobalt is slightly the greater. The values found for these elements compared with those obtained for copper and iron correspond with their relative positions in the table of atomic weights. These results obtained with secondary β radiation do not, therefore, point the conclusion suggested by Dr. Barkla, and are in good agreement with the chemical determination of the atomic weight of nickel.

F. F. HACKETT.

University College, Dublin.

Light Sense Organs in Xerophilous Stems.

IN view of the recent work of Haberlandt on the light sense organs of leaves, it may be of interest to record the discovery of similar organs in xerophilous stems. Certain of the epidermal cells of the young stems of the Ephedreæ have on their external wall conical structures of the nature of papillæ, the core of the papilla being mucilaginous. This structure acts as a collecting lens, focussing the incident rays of light, and a definite area of the cytoplasm of the back wall of the cell is thereby illuminated. Fig. 1, which is a photomicrograph taken

FIG. 1.—*Ephedra altissima* showing Light Spots.

in diffuse light of a mounted preparation of epidermis, shows the appearance of these light spots as seen under 1/6 objective.

Of any object held in the path of the incident rays an image is formed by each of these light sense organs.

Fig. 2 is a similar preparation to Fig. 1, but shows in each light spot the image of a hand held at a distance of about 2 feet in front of the microscope.

In the xerophilous Ephedreæ, where the assimilatory work is performed by the stems, and in correlation with

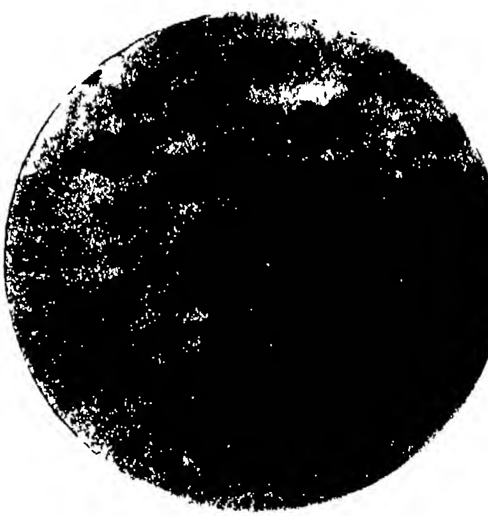


FIG. 2.—*Ephedra altissima* showing image of hand in each Light Spot.

which the histological character of the cortex is markedly similar to that found in the mesophyll of a leaf, the existence of such structures as these light sense organs so characteristic of leaves is not by any means unexpected.

An examination of other stems is in progress.

R. J. D. GRAHAM.

Botanical Department, University, St. Andrews, March 26.

THE LIVING WELWITSCHIA

IN the course of a botanical expedition[1] in Damaraland from Walfish Bay to Windhuk I spent some days in January and February in the littoral desert (the Namib), where in several localities Welwitschia is abundant. Speaking generally, the cones seen this year on January 22 and on later dates were considerably more advanced than those examined on January 15, 1904. The plants are flowering quite as profusely as they were three years ago, and, excepting a number of immature specimens, few were without cones.

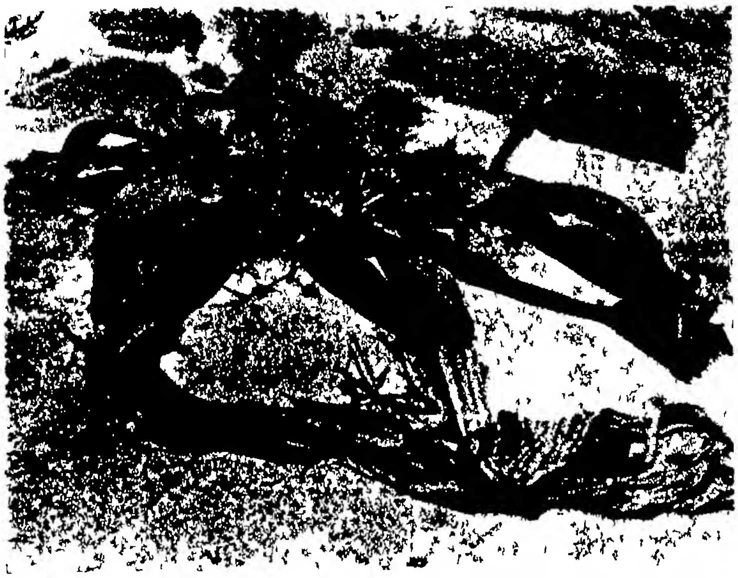


FIG. 1.—Welwitschia. Male Plant.

Fig. 1 shows a male plant the leaves of which are torn into broad bands. Baines might be forgiven for representing a plant not very different from this by the picture reproduced in Hooker's monograph (Plate i, Fig. 2). The tearing of the leaves into narrow strips which on the whole seems to be more characteristic is, I think, less common in the eastern part of the Damaraland area than in the west. The inflorescences (Fig. 2) compound dichasia with decussating branches, occasionally reduced to solitary sessile cones—are inserted in pits on the outer ridge of the stem just within the leaf base. The ridge in the axil of the leaf remains fertile for a number of years. The lower flowers of most of the cones seen in the photograph are open and their anthers are exserted.

The female plant shown in Fig. 3 bears an unusually large crop of cones. This is also an eastern plant, and the leaf-segments are few and broad. The bracts are deep, dull red in colour, except for a narrow margin of dark brown which extends for a short distance only on either side of the apex. The general effect is to mark out the four angles of the cone by longitudinal dark bands, which are separated by broader red bands along which the bracts overlap. In Fitch's picture (Hooker, Plate vii, Fig. 1) the angles of the cone are not sufficiently dark, and the colour of the remainder is too bright. The lower ovules appear to be pollinated. A drop of an intensely sweet viscous fluid was found on the summit of the projecting micropyle of each of the upper ovules during the day. It was not observed earlier than 9 a.m., but was common at 9.30 a.m. It remained there until after 3 p.m., but disappeared before sunset. Its formation was not due to a general increase in the turgidity of the plant, for it appeared before midday on inflorescences cut off in the early morning. Similar drops were seen under like conditions on all cones of corresponding size and colour.

I have elsewhere stated that the hemipteron *Odontopus sexpunctulatus* which in Damaraland is always found on the inflorescences during the hotter part of the day, is not a pollinating agent, and have inferred, contrary to the opinion of Schinz, that the relation between the insect and the plant is one of parasitism only. This statement, founded as it was upon too hasty observation, is incorrect. Fourteen specimens captured in different places, some from male and others from female plants, and examined microscopically were found in every case to bear pollen. The grains adhere singly or in masses to the smooth surface of the abdomen or are caught up among the short hairs on the limbs. I have observed that as the insect walks over the cone the abdomen is touched by the exserted anthers in the one case and by the fluid-tipped micropyle in the other. There can therefore be no doubt that Odontopus is an important pollen-carrier, though I believe, not the only one. The cones are also visited by a fly which is sometimes present in considerable numbers, and also by at least two species of Hymenoptera. In these cases the sweet fluid on the top of the micropyle is probably a source of attraction, but it

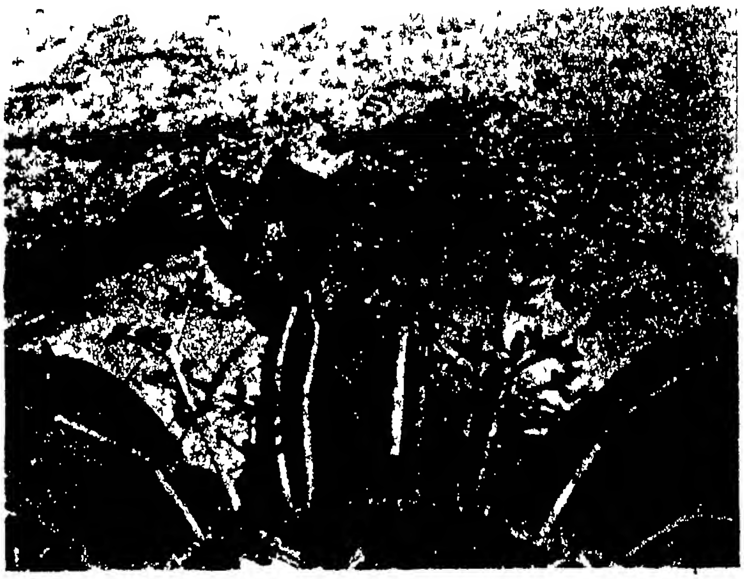


FIG. 2.—Inflorescences of Welwitschia.

[1] In part assisted by a grant from the British Association.

is less likely that it exercises a similar influence on the visits of Odontopus. It may be suggested that pollination was once mainly effected by insects in search of nectar, and that the relations which now exist between the plant and Odontopus have been more recently established. This is the more probable, since this insect is so widely distributed in regions where Welwitschia does not occur. Possibly the coloration of the bracts at the time of pollination is also connected with the process. Certain it is that before the micropyles appear above the bracts the latter are green, and the red colour appears about the time of pollination. Further, there is no trace of a red colour in the many old specimens of seeding cones that I have examined, but I have not been able to make sure that the colour disappears while the cone is still attached to the plant, though I believe this to be the case.[1] If this is so, the occurrence of yellow seeding cones in Hereroland specimens (as described by Pechuel-Losche) is at once explained.[1] The native in this picture (Fig. 3) is a Herero. The shrubs in the middle distance are Sarcocaulon sp.

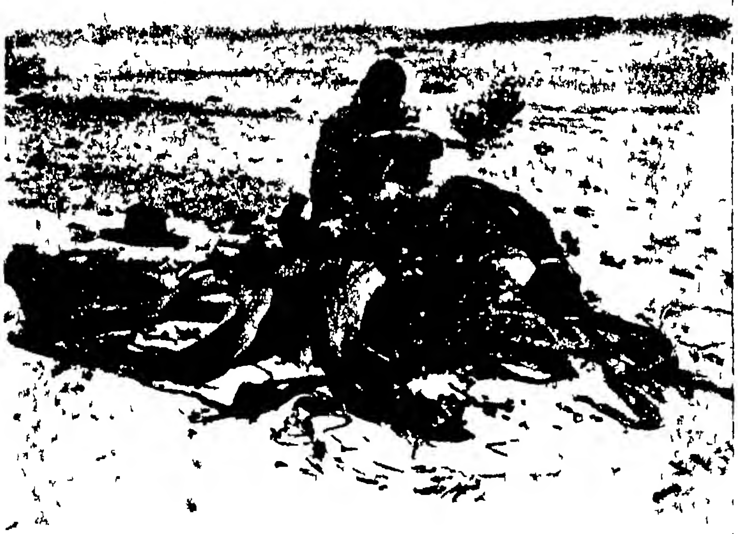


Fig. 3.—Welwitschia. Female Plant.

Through the kindness of Mr. K. Dinter, whose name is well known in connection with the botany of Damaraland, I was able to examine a bed of seedlings in the nursery of the forest department at Okahandya. The seeds were sown in July last in a deep, well-drained sandy soil, and germinated in about two weeks. A specimen which I was allowed to take up on February 7 had an exceedingly slender tap-root with a few short branches, the main root (the tip was left in the ground) measured 20.5 cm. below the feeder, the oldest branch being 11 cm. below the same level. The fairly stout hypocotyl was 2 cm. long, the foliage leaves 4.5 cm., the cotyledons were dry and shrivelled, and the lateral cones represented by small, vertically placed green lamellæ. The comparatively rapid elongation of the root, altogether out of proportion, on the one hand, to its own growth in thickness, and on the other to the increase in size of the aerial parts, points to the existence of a supreme necessity that the absorbing root should reach an underground source of water and as soon as possible render the plant independent of the very scanty and infrequent supply at the surface. In nature the conditions which would induce germination, and at the same time enable the root to penetrate the surface layers to a sufficient depth must very rarely occur, and it is not surprising that young seedlings have been searched for in vain. This apparent failure of natural reproduction by seed in recent years, when considered in relation to the large number of plants found within a comparatively small area and their obviously slow growth, suggests that the life conditions now prevailing in this Welwitschia area are more severe than formerly. There is other evidence also pointing to the same conclusion. Vegetative reproduction being entirely wanting, it is difficult to escape the conviction that, with the continuance of existing climatic conditions, the species, here, at least, is approaching extinction.

I am very deeply indebted to His Excellency Herr von Lindequist, Imperial Governor of German South-West Africa, and to Herr Regierungsrath Dr. Hintraeger, Acting Governor, through whose kindness every assistance which the Government could possibly give me in the study of Welwitschia and in a subsequent journey further inland was most generously afforded.

H. H. W. PEARSON.

1 Cf. Eichler, in Engler and Prantl "Pflanzenfamilien," ii. 1, p. 124 (footnote).

THE ART OF EMBALMING IN ANCIENT EGYPT.[1]

PROF. ELLIOT SMITH has applied to the study of mummification the accurate and thorough methods of observation which have won for him a foremost place among the younger generation of anatomists, the result being an authoritative memoir which will serve both the expert and the uninitiated as an excellent introduction to the art and significance of embalming as practised in ancient Egypt. As professor of anatomy in the medical school at Cairo he has free access to the material necessary for a first-hand study of the subject. So well has he pieced his evidence together that one obtains on reading it a very complete picture of the actual process employed by the embalmers during the twenty-first dynasty. The memoir is based on a study of forty-four mummies of priests and priestesses of Ammon, belonging to that dynasty.

Although the chief object of the author was to unravel the details of the embalmer's art, he carefully collected all evidence which might throw light on the significance of a custom which was practised for a period of at least two thousand years in Egypt—from the seventeenth dynasty until about 600 A.D. During the twenty-first dynasty embalming culminated in an elaborate technique which aimed at preserving the integrity of the skin and restoring the living form to the body. In explanation of the elaboration of technique during this period, Elliot Smith brings forward a suggestion of Dr. Reisner (in charge of the Hearst Egyptological Expedition of the University of California), namely, that the procedure had as its object a life-like preservation of the body so that it might serve as an abode for the *Ka* or "double" in place of the statue which was usually placed in the tomb along with the dead body to

1 "A Contribution to the Study of Mummification in Egypt." By Prof. G. Elliot Smith. Pp. 53+plates. Mémoires présentés à l'Institut Égyptien et publiés sous les auspices de S. A. Abbas II, Khédive d'Égypte, Tome v. Fasc. 1. (Cairo, 1906.)

answer this purpose. Whatever the object may have been there can be no doubt as to the tedious and complicated nature of the means employed.

Before the twenty-first dynasty, the process of embalming resulted in a mummy which was simply a *skeleton wrapped in a wrinkled covering of shrivelled skin*. In this dynasty, or at the close of the twentieth, the process of packing or "stuffing" was introduced to avoid the shrivelling of the flesh and distortion of the body which marred the work of the older embalmers. The mortal flesh was replaced by subcutaneous packings of durable material, such as mud, sand, lime and sawdust, with occasionally, in addition, of aromatic vegetable substances such as onion. The eyes of the great Rameses IV. were replaced by onions. After the twenty-first dynasty the art of embalming declined. Subcutaneous packing was discontinued, the surface form of the body being restored by swathing the limbs and body by an artistic application of bandages; later still all distortion was hidden by a free application of pitch and bandage to the shrunken trunk and limbs.

In the course of his investigations Elliot Smith was able to verify certain statements made by Herodotus and by Diodorus Siculus concerning the methods of embalming employed by the ancient Egyptians. Herodotus describes the extraction of the brain through a small opening made on the roof of the nasal cavity, a procedure which Greenhill characterised as "amusing and impracticable." It was found that all the mummies belonging to the seventeenth and later dynasties showed clear evidence of the truth of the ancient description; early in last century, T. J. Pettigrew also verified it. In the writings of Pettigrew and in Brugsch's translation of the Rhind Papyri, the author of the memoir found much that assisted him in re-constructing the details of the process used by the embalmers. Broadly speaking, there were three stages: (1) the viscera were removed from the body through a wound in the left flank, the heart being invariably left in the trunk; (2) the body was then placed in brine for a period of thirty or forty days, the viscera were preserved in a similar medium within the four "Canopic Jars," each of which was dedicated to one of the four children of Horus; (3) after removal from the salt bath the body, now much shrunken, was packed. From the arrangement of the packing Elliot Smith found it possible to tell the exact manner and order in which this had been accomplished; it is unnecessary here to mention the details, but one may safely state that these ancient embalmers must have had a very considerable knowledge of the anatomy of the human body.

The process of packing was finished by returning the contents of the four canopic jars to the body cavity; they were arranged in four packages and were usually replaced within the cavity in a certain definite order. In each package it was the custom to enclose the image of one of the four children of Horus—"funerary genii," as they are named in this memoir.

The following statement of Pettigrew is quoted in this connection:—

"To Amset were dedicated the stomach and large intestines, to Hapi the small intestines, to Smautf (Tuamâutef) the lungs and heart, and to Kebhsnuf the liver and gall bladder."

On this Prof. Elliot Smith makes the following commentary:—

"The examination of a still larger series of mummies of this period (twenty-first dynasty) has convinced me that, in spite of frequent irregularities, a definite association was intended—but the guardianship of the various Genii is by no means identical with that suggested by Pettigrew. Thus the human *Amset* is usually found wrapped up in the *liver* instead of the stomach and large intestines, the ape-headed *Hapi* is usually associated with the *left lung* rather than the small intestines, the Jackal *Tuamâutef* with the stomach ... and the hawk-headed *Kebhsnuf* ... in the parcel of intestines."

There are many other points in this memoir which are deserving of notice, but enough has been said to show its value as a real contribution to our knowledge of the ancient Egyptians.

ASTRONOMICAL REFRACTION.

WHEN a ray of light passes through a medium of uniform density the path described is a straight line. Should this ray meet obliquely another medium of different density it is bent or refracted. If the second medium is more dense than the first, then the ray as it enters the second medium is refracted towards the normal, or that line at right angles to the tangential plane at the point where the ray enters the second medium.

In the case of astronomical refraction, the light, say, from a star, passes through space and then penetrates the earth's atmosphere, a medium which is in all parts denser than the space between the star and the upper limit of the earth's atmosphere. By the time the ray reaches the observer it will therefore be considerably bent towards the normal. If our atmosphere were homogeneous, that is, if it were of equal density throughout, the star's light would pass in a straight line from the point where it first penetrated it to the observer's eye. We know, however, that our atmosphere is far from being of uniform density, and one has not to climb a mountain or ascend in a balloon very high before this fact is made plain.

Up to a few years ago little was known with certainty about the physical conditions of the upper atmosphere, except the broad idea that the air became less dense the greater the distance from the earth's surface, and that at the same time the temperature readings were lower and lower.

This limited knowledge of our atmospheric conditions rendered it necessary to make some assumptions as to the law of decrease of density. This was imperative, because it was of vital importance to astronomers and mariners to know how much the ray of light from a celestial object had been bent after it had penetrated our aerial envelope. In fact, what was required was the difference between the apparent and actual direction of the heavenly body in the sky.

The assumption finally made was that the atmosphere consisted of a series of concentric spherical layers the common centre of which was the centre of the earth. Each layer was considered of uniform density, and these densities or temperatures and refractive powers all decreased as the surface of the earth was left behind, the amount of decrease varying in a prescribed way and agreeing in the main with the actual, but few, observations made in balloons and on mountain tops. On this assumption, then, the ray which entered our atmosphere was always meeting with denser and warmer layers of air, and gradually becoming more and more bent as each consecutive layer was passed through.

During the course of the last few years very rapid strides have been made in investigating the upper air by means of manned and unmanned balloons and kites carrying meteorological instruments, and eleva-

tions have been reached which formerly were impossible to attain. The data collected at various heights above the earth's surface have now, therefore, become considerable, and our knowledge of the distribution of atmospheric temperature has in this way been greatly advanced. Thus it is known that the temperature does not gradually decrease as greater elevations are reached at the rate that was previously assumed. In fact, numerous records from automatic instruments have shown that at some heights quite considerable rises in temperature, extending through large depths of atmosphere, have been noted, these inversions being far more common than was at first contemplated.

With this condition of things so prominently brought out, it is at once obvious that some attention should be paid to a possible revision of the assumption on which the theory of astronomical refraction is based, because the path of a ray of light traversing such variously heated layers may not be the same as that computed on the old hypothesis.

Fortunately, this question is now receiving some attention, and this is shown by a recent preliminary paper by Prof. H. G. van de Sande Bakhuyzen entitled "On the Astronomical Refractions Corresponding to a Distribution of the Temperature derived from Balloon Ascents," which appeared in the *Koninklijke Akademie van Wetenschappen te Amsterdam* (January 20).

In this investigation Prof. Bakhuyzen has employed observations made on 182 different days, of which fifty-eight were made with unclouded and 124 with clouded sky. The ascents were made from Hald (in Denmark), Berlin, Paris, Strassburg, and Vienna, so that the values which he gives for temperatures at heights from 0 kilometre to 16 kilometres apply to the mean of the area enclosed by those stations. The values for the means above 13 kilometres are, as he states, not very certain, but the observations indicate that the temperature at these heights decreases slowly.

As this table is of considerable interest, a portion of it may be given here:—

Temperatures (centigrade) at heights from 0–16 kilometres for clear weather.

Height	Annual mean	Diff
0	+ 6 4	1 1
1	+ 5 3	− 4 3
2	+ 1 0	− 4 8
3	− 3 8	− 5 5
4	− 9 3	− 6 1
5	− 15 4	− 6 4
6	− 21 8	6 7
7	− 28 5	− 7 3
8	35 8	− 7 4
9	43 2	− 6 4
10	− 49 6	− 5 1
11	− 54 7	2 3
12	57 0	1 0
13	58 0	− 0 6
14	58 6	− 0 4
15	− 59 0	0 2
16	− 59 2	

The result of this preliminary investigation shows that when the refractions for zenith distances greater than 85° have been determined, the values for these alone are given in the paper, the values deviate perceptibly from those deduced from Ivory's theory.

Even if great weight be not put on this result, the inquiry is one which should undoubtedly be taken up again when more data are forthcoming. The astronomer of to-day is perhaps inclined to look upon the results of the computation of refraction by methods at present in use as strictly correct, but evidently due regard must now be paid to new data rendered available by atmospheric soundings. The subject of Prof. Bakhuyzen's inquiry is therefore of considerable importance, and future research in this direction will be followed with interest.

NOTES.

IN the issue of the *Revue Scientifique* for March 30 are reprinted portions of the funeral oration delivered by M. Briand, the Minister of Public Instruction, at the national funeral of M. and Mme. Berthelot at the Panthéon on March 25. M. Briand, speaking of Berthelot, said:—"The illustrious man of science, the great Frenchman for whom we mourn, was one of those colossal men who are an honour to every country and every age. He thought it the duty of every citizen to interest himself in the affairs of his city, and that is why his life was so multiplex, why his activities were exercised in such various directions. Probably he would have preferred to give all his time to his laboratory and his favourite studies, but when the public interest called him, when it looked to him to place his science at the service of the national defences of education, of general politics, Marcellin Berthelot did his duty simply, and we have thus to celebrate to-day at the same time the man of science, the philosopher, the educator, the politician, and *l'honnête homme*." Toward the close of his oration M. Briand remarked that he had been called by his position "to the painful and formidable honour of rendering homage, in the name of the Government, to the man of genius for whom universal science is in mourning," he then proceeded to give a touching eulogy of Berthelot as a private individual. The discourse serves admirably to show the high esteem in which the French people and rulers hold their great men of science.

DR. NANSEN will give a paper on "Polar Problems" at the Royal Geographical Society on Monday, April 29; on May 13 a paper on "An Expedition from the Niger to the Nile" will be read by Lieut. Boyd Alexander.

AT the recent annual meeting of the Royal Irish Academy Prof. F. A. Tarleton was elected president for the session 1907–8, and the following were elected honorary members in the section of science:—Profs. Ramon Y Cajal, Madrid; W. Ostwald, Leipzig; E. C. Pickering, Cambridge (Mass.), U.S.A.; and H. Poincaré, Paris.

A REUTER message from Constantinople reports that considerable damage has been done to property at Bitlis by violent earthquake shocks on March 29.

ON Tuesday, April 9, Prof. G. H. Bryan, F.R.S., will begin a course of two lectures at the Royal Institution on "Wings and Aeroplanes"; on Thursday, April 11, Prof. H. A. Miers, F.R.S., will commence a course of two lectures on "The Birth and Affinities of Crystals"; and on Saturday, April 13, Prof. Silvanus P. Thompson, F.R.S., will begin a course of three lectures on "Studies in Magnetism" (the Tyndall lectures). The Friday evening discourse on April 12 will be delivered by Prof. A. H. Church, F.R.S., the subject being "Conservation of Historic Buildings and Frescoes," and on April 19 by Prof. C. S. Sherrington, F.R.S., on "Nerve as a Master of Muscle."

MR. ANDREW CARNEGIE has invited a large party of guests from England to attend the dedication of the new building of the Carnegie Institute at Pittsburg, Pennsyl-

vania A large contingent of the party left Liverpool on Wednesday last for New York by the White Star steamer *Baltic*, among them being Sir Robert Ball, Provost and Mrs MacBeth, Prof Rhys, Principal of Jesus College, Oxford, Mr and Mrs John Robertson, and Dr John Ross

THE death is announced of Prof J K Rees, formerly professor of astronomy in Columbia University, New York Prof Rees was for two years president of the New York Academy of Sciences, and for fourteen years secretary of the American Meteorological Society His principal observational research was a study of the variation of terrestrial latitudes and the aberration of light made in cooperation with the Royal Observatory Naples This work was continued from 1893 to 1900, and was the first application of the method of simultaneous observations at two stations situated on the same parallel of latitude, but separated widely in longitude It was during Rees's professorship that Columbia University undertook the publication of Rutherford's series of star photographs He also established the Columbia summer school of geodesy and early recognised that practical field work in this subject is an indispensable adjunct in the training of civil engineers

AMONG the scientific subjects for which prizes are offered by the Reale Istituto Lombardo we note the following —for the Cagnola prize, April, 1907 on the discovery of radio-activity and its influence on modern physical and chemical theories, for 1908 on the present state of metallography in relation to the physical properties of metals particularly iron and steel, a general summary including some original results for the Fossati prize for 1907, on the so-called nuclei of origin and termination of the cranial nerves, for the Kramer prize for 1907, a discussion with certain practical applications of Guglielmini's hydraulic theories, for the Secco Comneno prize for 1907, a discovery relating to the virus of rabies, for 1911, on the physiological action of high-frequency currents As in previous years, other prizes are offered for literary and commercial subjects and for subjects which are the same every year For the present year the prize awards of the Reale Istituto Lombardo include a Cagnola prize of 100*l* and medal of value 20*l* to Dr Augusto Moschini of Pavia for his essay on the pathology of the suprarenal capsules, a prize of 80*l* to Dr Guido Sala of Pavia and awards of 20*l* to Prof Domenico Lo Monaco and G Pitò, of Rome, for essays on the anatomy of the visual centres of higher vertebrates under the Fossati foundation and Kramer prizes of 80*l* each to Ernesto Canalli, of Naples and Mario Baroni of Milan for essays on the resistance of structures in cement

A REUTER message states that Mr Walter Wellman will again attempt to reach the North Pole by airship during the coming summer The expedition steamer *Frithjof*, which is now at Trondhjem is to be ready to leave Tromso with the expedition on board for Spitsbergen, on June 1 The party will consist of about thirty-five men, and will proceed at once to the expedition base at Dane's Island established last year, where three men are now living The balloon part of the airship *America* has been rebuilt in the ateliers of M Mallet, Paris The airship is 183 feet in length with a greatest diameter of 52 feet. Its volume is 265 000 cubic feet, and when inflated the lifting force will be 19 500 lb The car itself is 115 feet in length, of steel tubing remarkably light and strong The backbone of this car is a steel reservoir of equal length to contain 1200 gallons (6800 lb) of petrol for the motors The principal motor, a 60 to 70 horse-power Clement, works directly on two steel screws, 11 5 feet in diameter, placed at each side of the car. The proper speed of this airship is sixteen to eighteen statute miles per hour, and the fuel carried gives 150 hours of motoring at full speed, radius of action, more than 2250 miles, or nearly double the distance from Spitsbergen to the Pole and back again All the mechanical part is being thoroughly tested by weeks of running, and at Spitsbergen trials will be made in the air of the completed ship before attempting the voyage to the Pole It is intended to reach the expedition base at Spitsbergen the first week in June to have trials of the airship in July, and to start for the Pole in the latter part of that month, or in the first half of August

A CORRESPONDENT sends us from Reval, Russia, some interesting particulars concerning the life and work of Dr Jakob Hurt, the "keeper of Esthonian folk-lore," who died on December 31 1906 (old style), to the great grief of all Esthonians Dr Hurt was born on July 10 (old style) 1839 at Wõru-maal (Werro district), Põlwa parish In 1859-65, he studied theology in the University of Tartu (now Jurjew), and after some years as lecturer in the gymnasium of that town was elected pastor to the parish church of Otepaa, where he remained from 1872–80 As the Esthonian population in St Petersburg grew, Dr Hurt was called to minister in their native tongue in the Church of St John where the Esthonian congregation numbers now about 30 000 souls He remained there from 1880 1901 His literary work was so great that he sacrificed his pastorage and devoted all his time to the native literature In his early years he became keenly interested in this subject, and listened to old folks' chants and legends which he recorded and published under the title of "Vana Kannel"—the Old Harp These songs awakened a strong feeling among the people, and a collection began in 1888 which is now represented by 160 volumes of MSS Only two volumes have appeared and a third is in print as "Setukeste Laulud," or the songs of Setukesed The whole national collection of Esthonian folk-lore now include 60 000 records of superstition 52,000 proverbs 45,000 folk songs, 40,000 enigmas, and 10 000 folk-tales The death of a folklorist who could accumulate such a vast amount of material is a loss, not to the Esthonians alone, but also to the world at large The Esthonians were almost a dead nation when Dr F R Kreutzwald (1803–1882) published his "Kalewipoeg"—the Esthonian Homer's "Iliad"—which brought them to notice The number of Esthonians is about one million The limit of the Esthonian language extends from Reval (Tallinn) so far south as Walk in Livonia There are many settlements of Esthonians in European Russia Caucasia, Siberia, and in the United States Canada, and other parts of the world It will be a great loss to the world if the valuable material collected by Dr Hurt is not preserved for future publication, and every effort should be made to secure this result The English Folk lore Society would probably help in this matter, and other societies might also do something The sacrifice of the collection would be a misfortune to science as well as to the Esthonian nation

SOME observations which help to explain the frequent occurrence of anhydrite in beds of gypsum have been made by Mr Louis C Kemp and are described in a note received from his father, Mr W. I Kemp Mr Kemp finds that anhydrite is readily formed from gypsum in solution in steam boiler working at 60 lb pressure per square inch Having occasion to examine some of the boiler sludge, precipitated from the mine water which had been used i

the boiler, he found the sludge to be almost pure anhydrite in fine crystals, and was confirmed in his observation by Dr Gerald T Moody, to whom part of the sample was sent.

ARE there any instances of church bells having been cracked by sound waves produced in air by explosions or heavy firing? A note in the *West Sussex Gazette* of March 28 suggests that this happened recently in the village of Appledram, Sussex Three volleys were fired by a naval party of twenty-four men over the grave of a seaman buried in the churchyard On the evening of the same day one of the church bells, nearly six hundred years old was found to be cracked The firing party was only about a dozen yards from the belfry, and it is believed that the vibration caused by the three intense sound waves in rapid succession cracked the bell It is well known that explosions and heavy firing have often broken windows but we do not remember any case of a bell being damaged in this way No windows were broken in the Appledram church, so apparently the effect was not due simply to compression waves It would be interesting to know whether there are other cases of bells having been cracked in the way that glass globes are said to have been broken when set in violent vibration by sound waves

ON January 8 Prof Willis I Moore, chief of the U S Weather Bureau, was asked by a committee on agriculture of the House of Representatives at Washington certain questions in regard to rainfall and change of climate in the United States The actual questions and answers have been reprinted in pamphlet form and the information given by Prof Moore is to the effect that the climate has in no way changed during recent years With regard to the rainfall in Kansas Nebraska, and other States, a table giving the means for thirty years in periods of ten years, clearly shows that the aggregate amounts have neither increased nor diminished to any extent worthy of consideration The first and last ten years were periods of fairly abundant rainfall, while in the middle ten years there was a deficiency During the last few years there has certainly been an excess of rainfall in some districts, but Prof Moore pointed out that as long a period of drought may be looked for later on This very natural and valuable opinion appears to have given offence to some newspapers in Kansas as being injurious to the States in question, and likely to prevent the sale of land Time will show that the attack they have made upon Prof Moore is both unwise and unwarranted His evidence is at least the outcome of knowledge obtained from a study of the best materials available to the Weather Bureau

INTEREST in natural history is encouraged by a series of articles on the country month by month which is appearing in *Pearson's Magazine* In addition to an illustrated article on the nature-story of April, with notes on the birds and flowers of the month and a calendar of the chief natural history events, the current number contains a contribution on the fertilisation of clover This article gives an instructive account, with several striking photographs, of cross-fertilisation of white Dutch clover by bees, but the remark that clover plants are "wise in their day and generation" because their structure favours this process is, to say the least, misleading Human attributes are implied even more definitely in the remark, "One cannot fail to admire the clover for its broad mindedness in not only thinking of its own immediate well-being, but working and arranging for the future, that its progeny should be vigorous and healthy" It is a pity to use expressions of this kind when referring to the functions of flowers A story entitled "A Message from the Moon" describes how an advertisement was projected by a parabolic reflector from the earth to the unilluminated part of the moon's surface The idea is ingenious enough, but unfortunately the author and his illustrator make the usual mistakes about the crescent moon The pictures show the advertisement on the dark part of an old crescent moon setting in a night scene, whereas such a crescent can, of course, only be seen shortly before sunrise The author takes the same liberties with the moon's motions by describing the moon as rising at New York at night in crescent form with the advertisement visible upon it for "upwards of three hours and a half, that is, until the moon was well overhead" We advise the author and the artist to make a few observations of the rising and setting crescent moons, and they will soon learn that the positions in which they place our satellite can never be realised in nature

WE have to acknowledge the receipt of a copy of a "Catalogue of British Orthoptera Neuroptera and Trichoptera" (fifteen pages) by the late C W Dale, published by Messrs Harwood, of Colchester

Museum News (Brooklyn N Y) for March records the bequest by Mrs C H Polhemus to the museum of a number of pictures, bronzes &c of the estimated value of 8000l , together with a sum of money for the preservation and increase of the collection

FROM the British Museum (Natural History) we have received a copy of a "List of British Seed-plants and Ferns," price 4d The list, which has been drawn up by Dr Rendle and Mr Britten, excludes some introduced and all exterminated plants as well as many of the phases of Rubus, Salix, &c together with the Channel Islands flora Plants which, although introduced, appear to have become naturalised, are indicated by italic type

A COPY of the second edition of the illustrated penny guide to the Hull Municipal Museum compiled by Mr T Sheppard, the curator, has been received The collections date from the year 1823, and include, among other valuable specimens the type-skeleton of Sibbald's rorqual (*Balaenoptera sibbaldi*), prepared from a carcase stranded at Spurn in 1836 and named by Gray in 1847 A photograph of this skeleton forms one of the illustrations

THE histology and development of the divided eyes of certain insects form the subject of a paper by Mr G D Shafer in the Proceedings of the Washington Academy of Sciences (vol viii , pp 459–486) The first part is devoted to the histology of the compound eyes of such forms as Sympetrum, the dragon-flies of the genus Anax and the midges of the genus Callibætis, which are divided by a curved line into an upper light-coloured and a lower dark moiety while in the second the author discusses the development of the large facetted area of the eye of the first and third of these groups In the case of the "turban-eye of Callibætis, the formation of a superposition image on the proximal and an apposition image on the distal retinulæ enables the eye with the superposition image to see, although perhaps indistinctly, in dim light where the small-facetted, deeply pigmented eye would be useless As these turban-eyes are restricted to the males of these may-flies which seek the females during flight in the gloaming, their use is obvious

'Meristic Homologies in Vertebrates' is the title of a thoughtful article by Mr J S Kingsley in the February number of the *American Naturalist* As one of the difficul

ties of the subject, the author points out that whereas mammals have twelve cranial nerves, in frogs and other ichthyopsidans the number is but ten. Consequently, the question arises whether the two additional nerves in the mammal are not due to the inclusion of two segments of the amphibian neck in the cranium of the former. If this be admitted there is a strong *primâ facie* probability that the occipital condyles of the frog are not the homological representatives of those of the mammal. On the other hand certain phenomena in annelids lead to the conclusion that segments, or somites, may be intercalated in various parts of the body by means of budding. If such a process exist in vertebrates, we could readily account for the two additional pairs of cranial nerves (representing as many segments) in the mammal as compared with the frog, without interfering with the homology of their condyles. So far, however, as the author is aware, no such budding zone is known in any vertebrate, and the hypothesis must consequently be regarded as merely of a tentative nature.

To the February number of the *Zoologist* Mr. T. Southwell contributes notes on Arctic whaling in 1906. The take of right whales was very small, the total number being only seven (four from East Greenland, two from Davis Strait, and one from Hudson Strait), and it was only the high price of bone, about 2500*l.* per ton—that rendered the venture profitable. The most noteworthy feature is the capture of the four whales in East Greenland waters, where none had previously been taken since 1889. The capture suggests that there are more whales in these waters than is generally believed, their accessibility or otherwise being largely dependent upon the condition of the ice. The author directs special attention to the capture of four Atlantic right whales by the Harris whalers, and likewise to the arrival of a cargo of "bone" from the same species (regarded a few years ago as nearly extinct) at New Bedford. In the March number of the same journal Mr. A. H. Paterson, of Yarmouth, gives some interesting particulars of the flocks of wildfowl and other birds which visited Norfolk at the time of the great snowfall of last Christmas. No less than about sixty swans were observed at Breydon, the majority of which appeared to be whoopers, although at least one is believed to have been of the Polish species, and pochards were vastly more numerous than for many years past.

PART III. of the fifth volume of *Biometrika* was issued in February. The opening article is Mr. Raymond Pearl's "Biometrical Study of Conjugation in Paramecium," concerning which some correspondence took place in our columns last autumn (vol. lxxiv., pp. 465, 584, 608). The memoir is of great interest. It is found that conjugants are differentiated from non-conjugants not only in type, as was well known, but also in variability and in correlation. Conjugant types from various sources differ less *inter se* than non-conjugants. The dimensions of the two members of a conjugant pair are highly correlated, and it is shown that this is almost certainly due to the fact that the two must fit—to put the matter shortly—or else they do not adhere, and sooner or later separate. The significance of these important results is discussed with care in considerable detail. Mr. J. F. Tocher contributes an account of an anthropometrical survey of the insane in Scotland, carried out at the cost of the Henderson trust under his direction; stature and head dimensions were measured, and pigmentation noted, for more than 8000 cases in the Scotch asylums. The memoir is illustrated by maps, and the whole of the original data are reprinted, by permission of the Henderson trust, as a supplement. A short article by "Student" deals with a point of practical interest, viz. the fluctuations of sampling to be expected in counting with a hæmacytometer, and in similar operations. For example, in order to obtain pure cultures of a yeast, the fluid is diluted until it is estimated that every two drops contain on the average one cell; different flasks are then seeded with one drop each, and it is assumed that "the majority of those flasks which show growth are pure cultures." But the question arises, what actual proportion may be expected to be pure? The answer is, about 76 per cent., 19 per cent. will have been seeded with two cells, and the remainder with three or more. As no references are given in the article, we may point out that the series used as a limit to the binomial when one of the chances is very small, is not novel; it was deduced by Poisson ("Recherches sur la Probabilité des Jugements," § 81, p. 206), and has been discussed in detail, with illustrations, by Bortkewitsch ("Das Gesetz der kleinen Zahlen," Leipzig, 1898).

AN account of the mosses collected at Westende and Coxyde, in Belgium, on the dunes, sands, and reclaimed lands known as "polders," combined with a discussion of the physiological factors regulating their distribution, is contributed by Dr. J. Massart to the *Bulletin du Jardin botanique*, Brussels, vol. i., No. 6. About sixty species were collected, of which *Syntrichia* (*Tortula*) *ruraliformis* was the most characteristic and widely spread.

IN the report of the Government laboratories at Manila for the year 1905–6 the superintendent, Mr. P. C. Freer, reviews the general lines of research carried out in the biological, chemical, and serum laboratories; he also formulates a plan for the establishment of a marine biological laboratory, and raises the question of founding a medical school in the Philippine Islands. Incidentally, Mr. Freer insists upon the necessity, that is not always rightly appreciated, for systematic botanical and entomological work, seeing that correct identification of plants or animals is an essential preliminary to the prosecution of investigation on economic products.

IN *Petermann's Mittheilungen*, vol. iii., part ii., Prof. F. Hock presents the first part of a study of the phytogeographical boundaries and regions of northern Germany. Beginning with the vegetation of East Prussia, the author states that the eastern boundary of the beech and the western limit of certain plants of the moors and swamps lie in this province, so that it may be regarded as a transition district between Russia and north-western Germany. The botanical region of north-western Germany is contrasted with the adjoining botanical provinces of lower Saxony, Schleswig-Holstein, and the Netherlands, all the latter containing various North Atlantic species that are absent in north-western Germany.

UNDER the title of the "Century Plant," Prof. W. Trelease contributes an article on the more important species of Agave to the March number of the *Popular Science Monthly*, New York. The chief value of many of the Agaves grown in Mexico lies in the fermented liquors prepared from the sap. In the plains of Apam, south of the City of Mexico, the sap is collected from extensive plantations of *Agave atrovirens* to make "pulque." "Mezcal" is a liquor obtained by distillation in another part of Mexico from *Agave Tequilana* and other species; "sotol" is the product of plants of the liliaceous genus Dasylirion. Reference is also made to the varieties that furnish sisal-hemp and other fibres.

BOTANICAL survey work concerned with the mapping of the vegetation of a given area according to a plan which is the outcome of a method suggested by Prof C Flahault, of Montpellier, has attracted a small but energetic band of workers in the United Kingdom The latest survey prepared by Mr. C E Moss, dealing with the distribution of vegetation in Somerset, was published in the *Geographical Journal* (October, 1906) In the lowland areas Mr Moss traces the transition from dunes fixed by sea-couch grass, *Agropyron junceum*, and marram grass, *Ammophila arundinacea*, to dune ponds and dune pastures, and so to maritime farmlands In another sequence of associations, the salt marsh, at first settled with Salicornia, is converted into land suitable for growing osiers and tree willows Similarly, typical series of formations are described for the upland areas, which are as markedly characteristic and easily recognised, so that the present paper provides an admirable introduction to anyone taking up the subject

MESSRS CARL ZEISS, of Jena, have forwarded a copy of their price-list relating to large projection apparatus This list contains a brief reference to everything necessary for the projection of microscopic objects, transparencies placed horizontally or vertically, and opaque objects Some general information is also given as to selection of the optical equipment for special purposes

IN the Journal of the Royal Microscopical Society, Mr J W Gordon describes a top stop for the microscope This is placed in the Ramsden circle of the instrument, its effect being to cut off the central part of every beam of light In this way the advantages of a wide aperture are preserved, and the definition is improved, as is well shown by the photographs illustrating the paper This improvement is attributed to the fact that in an unstopped beam the central and marginal parts do not exactly form the same image, and the confusion thus caused is obviated by the stop To cut off the marginal rays would be merely equivalent to using a narrower aperture

RECENT progress in the industry of perfumery and essential oils is ably summarised in a report by Messrs A Haller and H Gault in the *Bulletin de la Société d'Encouragement* (vol cix, No 2) Commercial statistics show that as a result of theoretical chemical researches there has been equal progress in the manufacture of natural essences and in the preparation of artificial perfumes

THE Engineering Standards Committee has issued a second report (No 26, London Crosby Lockwood and Son, price 10*s* 6*d*) of the locomotive committee on standard locomotives for Indian railways Four additional types of locomotive have been included at the request of the Indian Railway Board, and at the request of the Secretary of State for India the locomotive committee has formed itself into a permanent advisory body

AN address on the duration of the coal reserves of the United States, delivered by Mr Marius R Campbell to the National Geographic Society at Washington, is published in the *National Geographic Magazine* (vol xviii, No. 2). He enumerates the coal areas of the various States, and shows that, while Pennsylvania produces the most coal, Montana has the largest coalfields The total amount of coal in the United States, exclusive of Alaska is estimated at 2,200,000 million tons If the rate of consumption of 1905 were maintained indefinitely without change, this would last for 4000 years, but if the constantly increasing rate which has marked the consumption during the past ninety years be maintained, the coal supply will practically be exhausted within a hundred years

MESSRS F VIEWEG AND SON have just published (pp 417, price 12 marks) a fourth edition, revised and enlarged, of Prof Albert Ladenburg's well-known "Vortrage uber die Entwicklungsgeschichte der Chemie von Lavoisier bis zum Gegenwart," the first edition of which appeared so long ago as 1869 The main value of the work lies in the careful historical treatment of the progress of chemistry up to the time of the introduction of the conception of valency To bring the account up to date, however, additional chapters have been written for the new edition dealing with recent advances in physical chemistry, and including the theories of mass action, heterogeneous equilibrium, tautomerism, stereochemistry, and solution, a review is also given of recent discoveries in organic chemistry A special feature of this history is the very large number of references given to the original papers

A THIRD edition of Prof H Rottger's "Lehrbuch der Nahrungsmittel Chemie" has just been issued by the firm of J A Barth, of Leipzig (pp xiv+901, price 16 marks paper covers 17 marks bound) This work, probably for its completeness the most concise treatise on the chemistry of foods yet written, has gained in Germany a very high reputation, the second edition having been exhausted in a little more than three years To the new edition a number of tables and an index of authors' names have been added and a very complete set of references is given to the latest papers in all departments of the subject Third editions have also been published by F Tempsky, of Vienna, of Franz von Hemmelmayr's 'Lehrbuch der anorganischen Chemie" and "Lehrbuch der organischen Chemie" (pp 237 price 3 krone, and pp 150, price 2 30 krone, respectively), these books are designed for use in the fifth and sixth classes of the Austrian Realschulen, and are of a purely elementary character

SINCE the list of forthcoming scientific books appeared in NATURE of March 14, Messrs Swan Sonnenschein and Co, Ltd, have announced that they have in preparation — "The History and Ethnography of Africa South of the Zambezi from the Settlement of the Portuguese at Sofala in September, 1505, to the Conquest of the Cape Colony by Great Britain in September, 1795" by G M Theal, "Thought and Things a Study of the Development and Meaning of Thought or Genetic Logic," by Prof J M Baldwin, 3 vols vol ii, "Experimental Logic," vol iii, "Real Logic", "The History of Philosophy," based on the work of Dr J F Erdmann, fifth German edition, revised by Dr W B Erdmann, edited by W S Hough, "Lectures in Humanism," by Prof J S Mackenzie, "Mental Pathology and its Relation to Normal Psychology,' by Prof Storring, translated by Prof T Loveday, "Physiological Psychology," by Prof W Wundt a translation of the fifth and wholly re-written German edition by Prof E B Titchener, vol ii, "The Student's Text book of Zoology," by A Sedgwick, F R S vol iii completing the work and new editions of "Elementary Text-book of Practical Botany for the Botanical Laboratory and Private Student" by Prof E Strasburger, English edition by Prof W Hillhouse, and 'Handbook of Mosses" by J E Bagnall

OUR ASTRONOMICAL COLUMN

COMET 1907*a* (GIACOBINI).—The results of numerous observations of this comet are recorded in No. 4162 of the *Astronomische Nachrichten*, wherein there also appears a set of elements communicated by Prof. E. C. Pickering. On March 11, at Vienna, Dr. Rheden found that the comet was of the eleventh magnitude, and had a diameter of 30″ with a central condensation.

No. 4163 (March 20) of the same journal contains a set of elements and an ephemeris computed by the discoverer of the comet, and, according to the latter, the position on April 4, at 12h. (M.T. Paris), will be

$$\alpha = 6h.\ 19.5m.,\ \delta = +1^\circ\ 8'.5,$$

a point situated in Monoceros, and lying nearly half-way between ϵ Orionis and Procyon.

EPHEMERIS FOR THE MINOR PLANET (588) [1906 T.G.].—An ephemeris for the minor planet (588), extending from March 23 to June 19, is published in No. 4163 of the *Astronomische Nachrichten* by Dr. Bidschof. At present the planet is apparently in the constellation Leo, near to 91 Leonis, and is slowly travelling in a north-westerly direction; its magnitude is about 14.0.

SEARCH EPHEMERIS FOR COMET 1900 III (GIACOBINI).—A continuation of the ephemeris for the 1907 re-appearance of comet 1900 III is given by Herr Scharbe in No. 4163 of the *Astronomische Nachrichten*. The ephemeris based on the assumption that perihelion passage will take place on June 8 extends from April 6 to May 16, and others, allowing for slightly different rates of motion of the comet, are also given.

THE SOLAR ECLIPSE OF JANUARY 13.—The most recent eclipse of the sun was observed as a partial eclipse at the Zi-ka-wei Observatory, and the results of the terrestrial magnetism, temperature, actinometric, and other observations appear in No. 1156 (March 23) of *Cosmos*. The magnetographs showed nothing abnormal, but as shown by the curves which are given in the paper, there was a decided decrease from the normal both in temperature and actinism. The former began to fall about fifteen minutes after first contact, and began to recover its normal value at about twenty-seven minutes after the maximum phase. An Arago actinometer was employed, and the effect of the moon's interposition was observed much sooner than in the case of the ordinary thermometer. The times of the first and last contacts and of the disappearances of several groups of spots were also recorded.

MAN'S PLACE IN THE UNIVERSE.—In an article appearing in the April number of the *Fortnightly Review*, Prof. Turner returns to the discussion of Dr. Wallace's views regarding the unique position of the earth in the universe. It will be remembered that Dr. Wallace advanced reasons for the belief that the earth was at the centre of the universe, and, occupying this unique position, was possibly the only inhabited sphere. But, as Prof. Turner now points out, the researches of Prof. Kapteyn and, more recently and definitely, those of Mr. Eddington (see NATURE, No. 1938, December 20, 1906, p. 182) have shown that we have to consider the question of *two* universes, and this renders Dr. Wallace's position untenable unless the assumption is made that the solar system is the centre about which both universes oscillate.

THE ASTRONOMICAL SOCIETY OF ANTWERP.—We have received the second annual report of the Société d'Astronomie d'Anvers, dealing with the work performed by the society during last year. This society was founded for the purpose of popularising the study of astronomy amongst the inhabitants of the town, and appears to be fulfilling its purpose in an exceedingly business-like manner. An observatory has been opened, and is regularly used by the members, and, with the assistance of the city authorities, a course of free lectures on elementary astronomy is being given. The summaries of the first eleven lectures are published in the report, and these indicate that they should prove most instructive and worthy of emulation.

WIRELESS TELEGRAPHY IN LONGITUDE DETERMINATIONS.—A series of experimental determinations of longitude between Potsdam and the Brocken made by Prof. Albrecht during 1906, has shown that wireless telegraphy may be usefully employed for this purpose between stations not connected by the ordinary telegraph. In this case the older method has been previously employed, so that the relative precision of the two methods may be compared. In general, the differences were found to be of the order of one-thousandth of a second, and were not modified by any variation of the amount of energy used. The duration of the transmission was negligible, but it was found that atmospheric influences were more effective than in the case of ordinary telegraphy (*La Nature*, No. 1765, March 23).

ANCIENT CHINESE ASTRONOMY.—In an interesting paper appearing in the *Revue générale des Sciences*, No. 4 (February 28), M. de Saussure discusses the astronomical records contained in an ancient Chinese canonical work dating back to before 2300 B.C., and from the discussion arrives at some striking conclusions concerning the antiquity of systematic astronomical observation in China. The chief conclusion is that prior to 2000 B.C. the Chinese possessed instruments and the complete theory of their equatorial astronomy, in which they presumably observed certain selected stars situated near to the equator, and from these observations deduced the apparent position of the sun, and hence the progress of the seasons. That the inhabitants of Britain and of Egypt possessed the astronomical knowledge and the means to attain the same end—although by somewhat different methods—at an equally early date has been already demonstrated by Sir Norman Lockyer.

PUBLIC HEALTH

THE thirty-fourth annual report of the Local Government Board, 1904–5 (Supplement containing the Report of the Medical Officer, price 4s., London, 1906) commences with a useful summary of its contents by Mr. Power. Appendix A contains the provisions of the International Sanitary Convention of Paris, 1903, and of the West Indian Intercolonial Sanitary Convention, 1904, many reports by the Board's inspectors, statistical tables, and summaries by Dr. Bruce Low of the diffusion of plague and of cholera throughout the world in 1904. *Inter alia*, we are informed that vaccination is being increasingly adopted, the abstentions for 1903 being 14.7 per cent. of births as against 15.2 per cent. for 1902, and still higher for preceding years.

Appendix B contains the auxiliary scientific investigations carried out for the Board. Dr. Klein has investigated the transmission of plague in the rat, particularly by feeding. Feeding animals with cultures of the plague bacillus mixed with food having failed to infect, Dr. Klein conceived that if the organism were first protected from the digestive juices by drying it with the food, infection might occur; this was found to be the case, and in animals so infected the dejecta probably teem with bacilli. It was also found that earth or sand to which plague bacilli had been added in the form of gelatin cultures retained its infectivity for six to eight weeks.

Dr. Houston contributes a report on the bacteriological examination of deep well waters and of upland waters. The first section shows that *B. coli* is absent from 1000 c.c. of deep well water drawing its supply from distant and pure sources. The second section deals with the results of the examination of the waters of Loch Laggan and Loch Ericht (Inverness-shire). Loch Laggan is subject to a slight degree of pollution from human sources, Loch Ericht is not, and bacteriologically *B. coli* was contained in 10 c.c. in 33 per cent., and in 100 c.c. in 49 per cent., of Loch Laggan samples, while of Loch Ericht samples only 1 per cent. contained *B. coli* in 10 c.c. and 19 per cent. in 100 c.c. Dr. Houston therefore concludes that fish (of which the lochs contain abundance) and birds probably contribute little to the content of *coli*-like microbes, and that too stringent standards must not be adopted without topographical data.

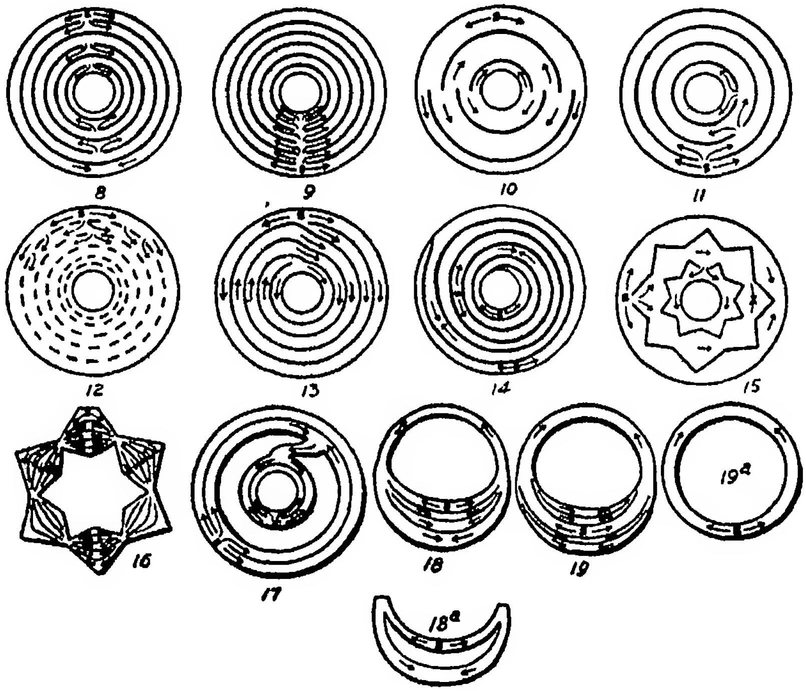
Dr. Sidney Martin has investigated the chemical products of the *B. enteritidis sporogenes*, but finds them to be without physiological action, also the specific agglutinins of various organisms.

Dr Gordon has sought for a bacteriological test whereby particles shed from the skins may be detected in the air He finds that a Staphylococcus (*S epidermidis albus* of Welch, with certain attributes) is by far the most frequent organism of the skin, and another Staphylococcus of the scalp Lastly, Dr Alan Green records further experiments on chloroformed vaccine lymph and on the combined use of chloroform and glycerin in preparing lymph The volume, therefore, contains much valuable matter, and is illustrated with a number of photographs

R T HEWLETT

PULSATION IN ANIMALS [1]

JELLY-FISHES have been the subjects of frequent experimentation—we need only refer to the admirable researches of Romanes—and Mr Alfred G Mayer, director of the Department of Marine Biology of the Carnegie Institution of Washington, has been able to draw some new and exceedingly interesting general conclusions from a study of their pulsations When the marginal sense-organs of the jelly-fish Cassiopea are cut off, the disc is paralysed and does not pulsate in sea-water If a ring-like cut, or a series of concentric broken-ring-like cuts, be made through the muscular tissue of the sub-umbrella, the mutilated disc (without marginal sense-organs) responds to a momentary stimulus, *e g* a mechanical or electrical shock, or a single touch with a crystal of potassium sulphate, and suddenly springs into unusually rapid rhythmical pulsation This is regular and sustained like clockwork and continues indefinitely in normal sea-water without further external stimulation The waves of pulsation all arise from the stimulated point, and the labyrinth of sub-umbrellar tissue around this centre must form a closed circuit—the stimulus being transmitted by the diffuse nervous or epithelial elements of the sub-umbrella Any cut that breaks the circuit stops the waves of pulsation, and continuous movement cannot again be started When each wave in a complete circuit returns to the centre it is reinforced and again sent out through the circuit The centre once established remains a fixed point, while the disc continues to pulsate The pulsation is fully twice as rapid as that of a normal Medusa, its rate varying with the length of the circuit, and it is self-sustaining (*i e* sustained by internal stimuli) once it be started by an external momentary stimulus



Shapes cut from discs without marginal sense-organs These will pulsate continuously in sea water The arrows indicate the paths of the waves of pulsation

Mr Mayer has endeavoured by numerous experiments to discover the *rôle* of the various salts in the sea-water and he finds that the sodium chloride is the chief stimulant to pulsation in Cassiopea, while magnesium is the chief restrainer of pulsation, and counteracts the influence of the sodium chloride Similarly, the heart of *Salpa democratica*, the heart of the embryo loggerhead turtle, and the branchial arms of the barnacle pulsate actively in solutions (*e g* Ringer's) containing only common salt, potassium and calcium, magnesium being absent Magnesium inhibits pulsation in all these cases Thus the general *rôle* of NaCl, K, and Ca in these cases is to combine to form a powerful stimulant producing an abnormally energetic pulsation, which, however, being exhausting cannot continue indefinitely, and magnesium is necessary to control and reduce this stimulus, so that the pulsating organ is merely upon the threshold of stimulation More concretely, the NaCl, K, and Ca of the sea-water unite in stimulating the pulsation of the jelly-fish, and in resisting the stupefying effect of the Mg, the general anaesthetic effect of which has been well known since the researches of Tullberg in 1892 All four salts conjointly produce in sea-water an indifferent, or balanced, fluid which neither stimulates nor stupefies the disc (*i e* the medusa with marginal sense-organs excised), and permits a recurring internal stimulus to produce rhythmic movement

Not only has the author shown us a new method of restoring pulsation in paralysed Medusæ, but he has demonstrated that magnesium plays a most important *rôle* in restraining, controlling, and thereby prolonging pulsation in animal organisms "Rhythmical pulsation can be maintained only when a stimulus and an inhibitor counteract one another, and cause the organism to be upon the threshold of stimulation, thus permitting weak internal stimuli to promote periodic contraction" Thus, once more, marine biology justifies itself in contributing to the progress of general physiology

J A T

[1] "Rhythmical Pulsation in Scyphomedusæ" By Alfred G Mayer Pp 62, illustrated. (Washington Carnegie Institution, 1906.)

THE WEATHER AND THE CROPS

AN interesting paper on the correlation between the weather and the crops, by Mr R H Hooker, head of the statistical branch of the Board of Agriculture was read before the Royal Statistical Society on January 15

The subject is very fully discussed by the method of correlation partial coefficients of correlation being determined between the produce of each crop and (1) the rainfall, (2) the accumulated temperature above 42° F during successive overlapping periods of eight weeks (first to eighth weeks of the year, fifth to twelfth, and so on) The crops dealt with include wheat, barley, oats, beans, peas, potatoes, turnips and swedes, mangolds, hay from clover and rotation grass and hay from permanent grass As climatic conditions differ so materially in England and Scotland and even in different parts of England, it was thought necessary to deal with a smaller area, and a group of eight

of the eastern counties was chosen for the purpose. The group includes the county with the largest acreage under each of the ten crops named, with the single exception of grass.

The results for wheat are of especial interest in connection with Dr. Shaw's conclusion as to the great importance of the autumn rainfall. Mr. Hooker confirms this, and finds, further, that the autumn is more important than any other period. The critical period is, however, probably somewhat shorter, the correlation of the produce with rain exhibiting a marked negative maximum for the thirty-seventh to forty-fourth weeks, the actual coefficient being −0.62; the coefficient with the rainfall of the cereal year as a whole is slightly greater still, viz. −0.69. There are two marked coefficients with the weather of the preceding summer, i.e. the summer of the year in which the seed for the crop was grown, viz. −0.49 with rain during the twenty-first to twenty-eighth weeks, and +0.51 with temperature for the twenty-ninth to thirty-sixth weeks, indicating absence of rain during the flowering period and warmth at harvest as necessary for good seed. For barley the chief requirement appears to be a cool summer, and for oats the same thing holds, but the latter crop also demands rain in spring, as indicated by a coefficient of +0.70. In the case of turnips, the highest coefficient, +0.55, is with the rainfall in June–July, i.e. the sowing season, this being partly due, in all probability, to the fact that in a dry season the turnip-fly will eat off a young crop almost as soon as it shows above the ground. In spite of prevalent opinion there does not seem to be any need for rain in late summer. In the case of the hay crops, the great value of the rainfall in spring and early summer is very well brought out, the coefficients attaining sharply marked maximum values of more than 0.7 in the spring.

One conclusion of remarkable generality is reached, viz. the advantage of cool weather during the late spring and summer for all the crops dealt with (except, perhaps, potatoes). Taking the period between the ninth and twenty-eighth weeks of the year, all the four coefficients with temperature are negative in the case of barley, oats, turnips, mangolds and hay; for wheat and for beans three of the four coefficients are negative. The correlation is with cool weather as such, and not with rain, as the effect of rain is practically eliminated by the method used. The result seems to indicate that grain and roots yield the most bulky crops if developed gradually and equably; neither rains nor heat, in fact, seem to be good for the crop for some time before harvest.

The paper also brings out very clearly another fact, viz. that the condition of the seed sown may be as important as the subsequent weather. As the condition of the seed is itself dependent on the weather of the year during which it was grown, this gives rise to the observed correlations between the crop and the weather of the seed year as well as that of the harvest year. Further, the meteorological conditions necessary for seed quality appear to be broadly speaking somewhat opposed to those necessary for a bulky crop. Thus, in the case of wheat, absence of rain during the flowering period and warmth at harvest were found to be necessary for good seed, but for a bulky crop cool weather is desirable. Considering all the coefficients with temperature for the ninth to thirty-sixth weeks, for wheat only one out of six is positive in the harvest year, five in the seed year; for barley none is positive in the harvest year, five in the seed year; for oats none in the harvest year, four in the seed year. This result would by itself suffice to account for the tendency observed in the case of cereals to an alternation of good and bad crops.

Although there is considerable uncertainty in some of the less well-marked results owing to the small number of observations available (twenty-one years), the application of the laborious methods used appears to have fully justified itself by the conclusions which have been thereby reached. How great the labour must have been may be judged from the number of correlation coefficients—between six and seven hundred—which have been tabulated by the author. The paper is published, with an abstract of the discussion which took place at the meeting, in the Journal of the Royal Statistical Society for March.

FLAME THE WORKING FLUID IN GAS AND PETROL ENGINES.[1]

FLAME produced by the combustion of inflammable gas or vapour and atmospheric air forms the working fluid of gas or petrol engines.

Mechanical power can be obtained by means of flame in several different methods:—

(1) By filling a vessel or cylinder with a mixture of gas and air, and igniting this mixture, a slight explosion is caused, and the excess pressure blows off through a valve. The temperature of the flame is very high, and so when it cools the pressure in the vessel is reduced below atmosphere. This reduction of pressure may be utilised by means of an engine operating by atmospheric pressure and discharging into a partly vacuous vessel, or by a piston moving into the vacuous vessel. This method may be called the explosion-vacuum method.

A modification of this method exists which may be called the flame vacuum method. In it the explosion is dispensed with.

(2) By admitting a charge of atmospheric air and inflammable gas or vapour at atmospheric pressure to a cylinder containing a piston, cutting off access to the atmosphere and the gas supply, and igniting the mixed charge, a mild explosion occurs; the pressure rises in the cylinder, and the piston is driven forward to the end of its stroke.

(3) By supplying to a cylinder containing a piston a mixture of inflammable gas and air in a compressed state and then igniting that mixture, a motive power can be obtained.

These last two methods, (2) and (3), are respectively known as the non-compression method and the compression method of operation in gas and petrol engines. The two methods were illustrated by a specially constructed apparatus. In this apparatus the cylinder of a petrol engine was mounted so that the piston reciprocated vertically, and a guide rod was fixed vertically on the cylinder. A hundred-pound weight was arranged to slide on this guide rod, and arrangements made by which a given charge of gas could be introduced into the cylinder. It was also arranged that the weight could be let down on to the piston, firstly so as to rest without compressing the charge, and secondly allowing compression of about 10 lb. per square inch. The mixture in the cylinder was ignited and, in the case where the charge was not compressed, the weight was thrown up by the explosion and expansion a distance of about 10 inches. In the case where the charge was compressed, the weight was thrown up about 18 inches, showing clearly the increased effect of the explosion of a given charge when under compression.

It is believed that this is the first time the effect of compression has been shown as a lecture experiment.

(4) A cylinder is supplied with gas and air under pressure, but the mixture is ignited at a grating or shield as it enters the cylinder, and so the pressure in the cylinder never rises above the pressure at which it is supplied. The power here is obtained without any increase in pressure, and is due to the fact that a small volume of cool mixture, when inflamed, becomes a larger volume, so that although a pump may be used to compress mixture the expansion in the motor side is greater, although at the same pressure as the pressure in the pump.

These four modes of action were all illustrated by means of specially constructed apparatus, in which the effect of the working flame could be seen. The four modes of action, and combinations or modifications of them, include all the fundamental methods used in obtaining motive power from flame which have been attempted by mankind for the last hundred years. In the year 1820 the Rev. W. Cecil, of Cambridge, read a paper at the Cambridge Philosophical Society in which he described an engine which he had constructed to operate according to the explosion-vacuum method, and he states that at sixty revolutions per minute the explosions take place with perfect regularity. His engine consumed, he stated, 17.6 cubic feet of hydrogen gas per hour. He also mentions an engine operated in accordance with the second method, the non-compression explosion method, and one

[1] Abstract of a discourse delivered at the Royal Institution on Friday, February 22, by Mr. Dugald Clerk.

also operated by gunpowder This paper gives an account of the first gas engine which appears to have been worked in Britain or elsewhere

Six years later Samuel Brown invented and built an ingenious engine, depending on the flame-vacuum method, which appears to have been the earliest gas engine ever worked on any considerable scale In an early number of the *Mechanics' Magazine* it is stated that Brown succeeded with his engine in propelling a boat upon the Thames and in actuating a road locomotive This vacuum method, however, never produced a really commercial engine, its only survival being the small engine shown as illustrating a modified form of class (1)

Many engines have been built using the atmospheric, or, as it is more commonly known, the non-compression explosion principle, but the most successful was that of Lenoir The simplest engine of this type was one which was used in considerable numbers until a comparatively recent date—the Bischoff engine In it a mixture of gas and air is drawn into the cylinder through suitable valves As the piston passes an igniting aperture the flame is sucked in, the mixture ignites, and a small check valve closes the flame or touch-hole aperture In the Lenoir engine, which was the most successful of this type, however, many of the modern characteristics are found such as the water-jacket and ignition by the electric spark The gas consumption, however, of all these engines was very high, rather more than 90 cubic feet per indicated horse-power per hour The power obtained for given dimensions, too, was very small

The first and second methods accordingly are not now used Their disadvantages proved too great In all modern gas or petrol engines the third method is used that is, the charge of inflammable mixture is compressed before ignition

Many attempts to construct engines operating on the compression principle were made before success was obtained In such attempts England had a full share One of the very earliest feasible compression gas engines was that described by William Barnett, an Englishman, in the year 1838 This engine had many of the features of successful engines of to-day Later proposals were made for similar engines, both in France and in Germany, but the first inventor to succeed in overcoming difficulties to a sufficient extent to produce a commercial engine was the late Dr Otto of Deutz To Dr Otto belongs the honour of producing the first successful compression gas engine The great majority of modern gas and petrol engines operate on what is now known as the Otto cycle The production of a compressed charge in a motor cylinder in a safe, quiet, and economical manner is a much more difficult problem than appears at first sight Those of us upon whom fell the brunt of working out this problem about thirty years ago appreciate fully the ability and knowledge displayed by the late Dr Otto in producing his famous engine In the Otto engine the characteristic feature is found in the alternate use of the same piston and cylinder for the purpose of pump and motor In one complete revolution the cylinder is used as a pump, and in another complete revolution as a motor The cycle is very simple

The Otto cycle has many great advantages The charging and discharging of the gases is accomplished easily The heat flow through the sides of the cylinder is not too continuous and consequently the cycle can be operated at very high speeds Many attempts, however, have been made to obviate the main disadvantage of the Otto cycle, that is, the necessity for two complete revolutions for every power impulse In 1881 the lecturer invented a cycle of operations which gave in the same cylinder one power impulse at each revolution This cycle is now known as the Clerk cycle and it comes next to the Otto cycle in order of number of engines now running in the world Sections showing the operation of the Clerk cycle were shown Its characteristic consists of open ports at the outer end of the stroke which are overrun by the piston The pressure in the cylinder rapidly falls to atmosphere, and a charge is forced into the cylinder at low pressure, about 2 lb above atmosphere This displaces the exhaust products remaining in the cylinder, and furnishes the fresh charge, which is compressed on the return stroke into a space at the end of the cylinder This charge is ignited, and in this way a power impulse is obtained for every forward stroke of the piston A second cylinder is required in order to supply the charge The second cylinder is very light in construction, both as to the cylinder itself, the piston, and the connecting rod and cranks driving it Working sections of a Clerk engine and Lanchester engine were shown

The last thirty years have seen the greatest development, so far as practical matters are concerned so that now more than two million horse-power of stationary gas engines operated by flame are in use in the world It is difficult to form an estimate of the power of motor-car engines in use but probably it now exceeds a million horse-power

Although great progress has been made in the practical control and utilisation of flame and gaseous explosions for the purpose of producing motive power, little is as yet known as to the actual properties of the flame working fluid so utilised Accordingly, for the present it is not possible to formulate a complete theory of the internal-combustion motor The subject is a difficult one, and involves not only the statical properties of these gases but requires a knowledge of the conditions and rate of chemical combinations occurring in minute fractions of a second, and of the conditions of dissociation of compounds such as carbonic acid and steam at high temperatures under varying conditions of temperature and pressure Many distinguished investigators have given the subject some attention Bunsen in 1866 arranged a small glass tube with a safety valve, and weights to apply pressure to the valve He provided platinum points between which the electric spark could be passed the whole length of the tubular vessel This vessel was filled with various explosive mixtures and ignited by the spark The valve was loaded until it just blew off This blow-off pressure was considered to be the maximum pressure produced by the explosion Bunsen's apparatus was very crude, and could not have been expected to give accurate results The maximum pressures must have far exceeded the pressures registered by his apparatus Messrs Mallard and Le Chatelier and Berthelot and Vieille took up the subject of gaseous explosions, and made experiments also with numerous gases and oxygen, and coal-gas and air A series of experiments was made by the lecturer in 1883 A Richards indicator, of the best construction known at that date, was used and secured indications which were fairly trustworthy Curves of explosion and cooling with coal-gas so obtained were shown These experiments also showed clearly that the whole of the heat present was not evolved at maximum temperature assuming the gases to have their ordinary specific heat at the high temperatures as well as low Messrs Mallard and Le Chatelier and Berthelot and Vieille had come to the conclusion that the specific heat of the gases had been changed, and they considered combustion to be complete at the maximum temperature or nearly so The lecturer's experience with engine indicator cards supplementing the experiments made with gas and air mixtures in a closed vessel led to the view that combustion was not complete and that therefore it was not safe to draw deductions as to varying specific heat without quite definite knowledge that chemical combination was completed before determinations were made of specific heat value The absence of definite knowledge as to specific heats at high temperatures, dissociation and rates of continued combustion, made it impossible to develop any complete theory of the internal-combustion motor

To enable some investigation, however, to be made on different engine cycles it appeared desirable to consider the gas engine as an air engine pure and simple operated with air of constant specific heat the air being a perfect gas and the chemical action being assumed as merely a means of heating the air through the desired temperature range Calculating on this simplified theory it became evident that the efficiency to be obtained in an air engine without heat losses was dependent upon compression mainly Working out this theory showed that while the utmost that could be theoretically expected from a non compression engine of the Lenoir type was 22 per cent compression supplied means of getting theoretical efficiencies as high as 60 per cent, with practicable ranges

of compressions Considering, then, gas and petrol engines as air engines, the theory is very simple There are three symmetrical cycles of compression air engines It is interesting to note that for equal compressions it does not matter whether Carnot cycle, constant volume, or constant pressure engines be used—the theoretical efficiency is the same It has been found in practice that a first-class modern engine operating on the constant-volume cycle will give in indicated power 0·7 of the heat which a perfect air engine would give under the same conditions of compression, proportions, &c Thus an engine having an air-engine efficiency of 0·5 will give indicated work 0·5×0·7=0·35, of all the heat given to it

The air standard has proved its utility as a guide to the engineer for twenty-five years now, and has been adopted by a committee appointed by the Institution of Civil Engineers on the standards of efficiency in internal-combustion engines. To enable further progress to be made, however, it is now necessary to know more of the actual properties of the working fluid

The earlier experiments made by the lecturer, and subsequent experiments made by Oliver in America, and by Messrs Bairstow and Alexander in this country, were only in strictness applicable to the behaviour of highly heated gases in a closed vessel No means of obtaining a cooling curve in an engine cylinder had been proposed

At the beginning of 1905 the lecturer designed a new method, and made a considerable number of experiments on a 50-horse-power gas engine By altering the valve arrangements of the engine so that when desired both inlet charge valve and exhaust valve can be held closed, diagrams were obtained from which a cooling curve was calculated

In this method no gases are allowed to exhaust from the cylinder The piston accordingly compresses the whole contents into the compression space, and the temperature which has fallen by expansion rises by compression A point is touched on a vertical line from the end of the card On expanding, a line below the first compression line is traced, then another compression line is obtained, and so on, a series of compression and expansion lines is obtained each terminating under compression at certain specific points

In this way a cooling curve is obtained which shows the real temperature drop upon the expanding and compressing lines From this curve, by somewhat troublesome calculations the mean apparent specific heat of the charge can be obtained for each expanding line A curve of specific heats so obtained was shown

These numbers give a very fair indication of the heat loss incurred in the cylinder, and the cooling curves show that for the whole stroke the mean temperature of the whole enclosing walls is about 70° C when the water-jacket is cold and about 200° C when the water-jacket is hot, but for the inner part of the stroke, the first three-tenths of the stroke, the mean temperature is much higher —170° C when cold and 400° C when hot

This method of investigation gives a more accurate knowledge of the properties of the working fluid so far as the thermodynamics of the engine are concerned, and it enables us to make an entire heat balance sheet from the diagram only Full load diagrams taken from the engine have been examined by this method, and account for 105 thermal units, when the calorimeter shows 106 thermal units to be present The method appears capable of very considerable accuracy

Prof Hopkinson has attacked the problem of heat loss to the closed vessel by another method using a calorimeter by which the heat leaving the hot gases at any time is measured electrically, while at the same time the pressure is indicated This arrangement promises to give important information as to the rate of loss in gaseous explosions, from which observations some deductions may be drawn as to specific heat and as to time of termination of combustion

The lecturer is continuing investigations on various sizes of engines with a new form of optical indicator An indicator card taken with this instrument was shown The appearance of this indicator card is most interesting There is slight discontinuity in the rising line, and just as maximum pressure is approached the indicator begins to oscillate rapidly through a small distance These oscillations continue all down the explosion stroke, die out gradually, and do not terminate until the end of the compression stroke The period of the oscillations is about 600 per second, the amplitude gradually decreases until it has practically ceased at the end of the first compression.

The period of the indicator is about 200 to the second, so far as ordinary piston displacement is concerned From this it follows that considerable pressure disturbances within the cylinder must have occasioned the oscillation In this particular engine, the explosion is always accompanied by a peculiar whistling sound, which seems to start just about the time the diagrams show the beginning of the oscillations, that is, immediately after ignition It is somewhat difficult to account for this peculiar action, but it appears to have some connection with the discontinuous nature of combustion of a mixture of inflammable gas or vapour with air This was illustrated by an experiment in which inflammable mixture was ignited at the open end of a long tube The flame travels back along the tube accompanied at first by a low, roaring sound, which increases in intensity as the end of the tube is reached, terminating in a loud snap When this occurs, the flame flashes back again, and there is obvious oscillation of some kind proceeding It is not known why the mixture flame burns in this way, but this particular roaring or whistling seems to occur only when combustion is going on, and is noticed in all pressure flames in the open air It appears highly probable, then that wherever this oscillation goes on combustion is still proceeding

Experiments have also been made by Messrs Holborn and Austen on the specific heat of air and carbonic acid by an entirely different method, and there is reason to hope that as a result of experiments which are progressing in this country and on the Continent the whole question will be cleared up in the next few years in a satisfactory manner

As one who has given thirty years' study to the practical and scientific problems involved in this matter, it is exceedingly gratifying to find a great and increasing interest in the subject which will lead to the complete investigation of the complex properties of the working fluid

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Dr W Peddie, lecturer in natural philosophy in the University of Edinburgh, has been appointed to the Harris chair of physics in University College, Dundee, in succession to Prof Kuenen

Prof Miall, F R S, who was appointed professor of biology in the Yorkshire College of Science in 1876, is retiring from his chair in the University of Leeds at the end of the present session We understand that the council has decided to establish separate chairs of zoology and botany, and will shortly proceed to appoint professors of these subjects

The province of Saskatchewan is only eighteen months old, but already (says the *Times*) it is devoting its resources to the establishment of a State university A Bill just introduced by the Provincial Government in the Legislative Assembly at Regina provides for the incorporation of such a university under a chancellor, convocation, senate board of governors, and council The number and nature of the faculties to be established will be decided by the university senate The maintenance of the university is to be provided out of the general revenues of the province and also by a percentage of the net receipts of the province under the Succession Duties Ordinance.

There has been serious divergence of opinion for more than two years as to the policy of the Marine Biological Association of the West of Scotland This association was founded in order, according to the first article of its constitution, to investigate the marine fauna and flora of the Clyde sea area, to maintain a biological station at Millport or other suitable locality, and generally to foster and encourage biological research At the annual meeting of the association on March 27 an amendment was carried by a majority of one vote "that while approving generally

of the report, the meeting does not approve of the staff being employed in biological survey" The chairman Dr. Rottenburg, Prof Bower, Prof Graham Kerr, Prof Lawrie, Dr Teacher, Mr F J Bles, Mr Todd, the honorary secretary, and other members of the general committee then tendered their resignations and withdrew from the meeting.

The council of the Association of Teachers in Technical Institutions recently appointed a committee to report upon the mathematical syllabuses of the Board of Education, and the recommendations of the committee have been embodied in an "outline of suggested syllabuses" which has been sent by the council to the Secretary of the Board of Education Several principles guided the council in drawing up its suggestions It urges that there should be a progressive development in pure geometry analytical geometry and analysis in each of the six stages into which the examinations of the Board are divided, that the six stages should give a homogeneous and comprehensive education in the main principles of the science and that the course of work for honours examinations should be such as to place the student in a position to undertake original investigations should he desire to do so It is a hopeful sign that teachers are able to lay before the Board of Education their views as to what it is reasonable and desirable to expect of candidates in examinations and we have no doubt the Board will give the suggestions the consideration they deserve Certain of the recommendations will be improved, no doubt by submission to revision, but the cooperation of teachers with outside authorities in the examination of students deserves every encouragement

According to an address delivered by Miss Hoskyns Abrahall in the Memorial Hall Manchester, and published by the Manchester and Salford Sanitary Association, the system of popular education now current needs radical amendment in order to prevent further physical degeneration on the part of the lower-class population of the country The system now in vogue is regarded as essentially non-hygienic, especially so far as infants and young children are concerned The maintenance of silence and order in infant schools (formerly regarded as a piece of mental discipline) is condemned, and in lieu of this it is urged that the pupils should be put to play in a large empty apartment with "a heap of sand in one corner and a tub of water in another" It may be pointed out that much the same results could be attained without expense by allowing the children to play in the old-fashioned way in the streets or lanes Nearly as drastic amendments are proposed in the curriculum for older pupils, while it is also urged that these should be kept at school until a considerably later age than is now the practice Neither is the education of teachers anything like perfect, one of the elements lacking being "skilled observation of children and skilful handling of them in accordance with what has been observed"

SOCIETIES AND ACADEMIES

London

Royal Society, November 1 1906—"On Intravascular Coagulation in Albinoes and Pigmented Animals and on the Behaviour of the Nucleo-proteids of Testes in Solution in the Production of Intravascular Coagulation" By G. P. **Mudge**. Communicated by Dr A D Waller F R S

(1) When albinoes are injected with a solution of nucleo-proteid derived from a pigmented animal, a certain number of them, about 9 per cent, absolutely fail to clot, while about 7 per cent give a *qualified clotting*, the remainder giving a typical intravascular coagulation of more or less extensive development

(2) When albinoes are similarly injected with a solution of nucleo-proteid, but derived from albinoes, no absolute failure of coagulation occurs, and it is very doubtful if any qualified ones do The great majority clot as distinctly as do pigmented individuals

(3) When pigmented rabbits are injected with solutions of nucleo-proteids, derived from albinoes or with those derived from pigmented individuals, no failures of coagulation occur

(4) The Himalayan rabbit in respect of its reaction to injected nucleo-proteids, behaves like the complete albino This rabbit, though resembling the Norway hare in its winter coat, in which condition Pickering failed to obtain intravascular coagulation, differs from it in having pink (unpigmented) instead of pigmented eyes and in never becoming periodically wholly pigmented It cannot, therefore be used as corroborative evidence of Pickering's conclusion with respect to the Norway hare

(5) Failures to coagulate, when they occur are due to inherent qualities of the individuals and not to weakening in the activity of the solutions used

(6) Albinoes require a larger mean dose per kilogram of body weight of injected nucleo-proteid to cause death by intravascular coagulation than do pigmented animals, the relative resisting powers of the pigmented and albino individuals being as 1 to 1 5 respectively

(7) Both albino and pigmented individuals are more resistant to nucleo-proteids obtained from individuals of their own race than they are to those obtained from the alternative source

(8) The activity of a solution of nucleo-proteid prepared from spermatic glands decreases (but not quite uniformly) as the maturity (weight) of the gland increases

(9) Solutions of nucleo proteids prepared from heavier (maturer) spermatic glands undergo a progressive loss of activity with increasing period of keeping *i e* from one to twenty days But solutions derived from lighter (immature) glands undergo a fluctuating variation in activity, falling off on the second day after preparation and rising again on the fifth to seventh, and thence exhibiting a progressive fall

January 24—"Note on the Application of Van der Waals's Equation to Solutions" By the Earl of **Berkeley** Communicated by Prof J Larmor, Sec R S

The author attempts to apply Van der Waals's equation of state to the results of direct measurements of osmotic pressure at 0° C Various modifications of this equation were tried without success but by the introduction of a third constant two equations were found that fit the experimental numbers

The equations are —

$$(A/v-p+a/v^2)(v-b)=RT \qquad (1)$$
$$(A/v+p-a/v^2)(v-b)=RT \qquad (2)$$

where p is the osmotic pressure, R and T the gas constant and the absolute temperature respectively, while the v of equation (1) is the volume of water which contains 1 gram molecule of solute, and the v of equation (2) is the volume of solution containing the gram molecule

It is pointed out that both equations give impossible values for the critical points, but on plotting the graph of equation (1) for the different substances, it is found that in each case the point at which $dp/dv=0$ and the osmotic pressure decreases with increase of concentration may be within the reach of experiment Decrease of osmotic pressure with increase of concentration implies physical instability and change of state, hence it is suggested that when $dp/dv=0$ the limit of supersaturation has been reached, and the solute must crystallise out

It is shown that a solution has two osmotic pressures the second osmotic pressure (which would only be manifested directly if one could find a semi-permeable membrane permeable to the *solute*) is connected with the freezing point of the solution in a manner similar to that which connects the crystallising point and the ordinary osmotic pressure

"On the Presence of Europium in Stars" By Joseph **Lunt**. Communicated by Sir David Gill, K C B F R S

Having obtained, from measures on the calcium line λ 4435 851 in the spectra of α Boötis and β Geminorum, radial-velocity values which were not in accord with those obtained from other stellar lines, the author suspected that the line near λ 4435 8 in the stars named was not a "pure" one The resulting radial velocity was such as would be given by a "disturbing" line very close to the calcium line and at about λ 4435 753 Reference to records of laboratory spectra showed him that Exner

and Hasselberg gave a strong line of europium at λ 4435·75. A search for other strong europium lines in the Arcturus spectrum revealed several abnormally strong stellar lines agreeing closely in position with the europium lines, and the author concludes that these cannot be explained without involving the rare element in question. Incidentally he reviews the evidence for the occurrence of the same element in the sun's chromosphere, and confirms Prof. Dyson's previous conclusions that europium is represented.

January 31.—"On the Discharge of Negative Electricity from Hot Calcium and from Lime." By Dr. Frank **Horton**. Communicated by Prof. J. J. Thomson, F.R.S.

This paper contains an account of some experiments in which the negative leak from hot calcium was compared with that from platinum and from lime under similar conditions. The negative leak from a platinum strip heated by an electric current was first investigated. This strip was then covered with metallic calcium by sublimation from an electrically-heated calcium wire situated in the discharge tube near to the kathode. The negative leak from the calcium-covered strip was determined at different temperatures. Some pure oxygen was then let into the apparatus, and the calcium on the kathode was oxidised to lime. The excess of oxygen was then removed and the negative leak again measured. Finally hydrogen was let into the apparatus, and the effect of this gas on the negative leak from lime was investigated.

The results obtained may be summarised as follows:—

(1) The negative leak from calcium is greater than from platinum at the same temperature.

(2) On oxidising the calcium on the kathode to lime there is a great increase in the negative leak. This is contrary to expectation, for we should expect the presence in the molecule of lime of the electronegative atom of oxygen to act as an attracting force tending to retain the escaping corpuscle, and that consequently the leak from lime would be less than from calcium under the same conditions.

(3) The negative leak from lime in hydrogen is much greater than that in air or helium.

February 28.—"The Occlusion of the Residual Gas by the Glass Walls of Vacuum Tubes." By A. A. Campbell **Swinton**. Communicated by Sir William Crookes, F.R.S.

On strongly heating portions of the glass walls of vacuum tubes that had been subjected to severe use in 1898, and had since been open to atmospheric pressure, they immediately became clouded, the effect being due to quantities of minute spherical bubbles of gas, which could be clearly seen with a microscope, and were on the average about 0·01 mm. in diameter. By dissolving away one surface of the glass with hydrofluoric acid until the bubbles just disappeared, and measuring the thickness before and after this process, it was ascertained that the bubbles were about 0·122 mm. from the inner surface of the glass. It would therefore appear that the particles of gas must have been shot into the glass to about this depth.

In a typical case the number of bubbles per square centimetre was found to be about 625,000, from which it was calculated that the total amount of gas at atmospheric pressure occluded in the particular tube was nearly 0·05 cm., apart from any further amount that may have escaped on the heating of the glass.

A number of pieces of the glass were next placed in a flat and air-tight tin chamber connected with a vacuum pump and a spectrum tube. This was exhausted until no electric discharge would pass through the spectrum tube, and was then hammered so as to powder the glass. There was an immediate fall of vacuum, and on examination with a spectroscope the gas that had been evolved was found to be mainly hydrogen. This process was repeated several times, the result in each case being to bring out more hydrogen. It would therefore appear that the gas occluded in vacuum tubes exhausted in the ordinary manner from atmosphere is almost entirely hydrogen, due, no doubt, to the electrolysis of water vapour.

Further experiments were tried with helium. A new tube was first exhausted until no discharge would pass, and then helium was admitted in small quantities from time to time with intervening sparking until 1 cubic centimetre at atmospheric pressure had been absorbed. The glass of this tube showed bubbles when heated, and on placing some of it in a vacuum chamber, as before described, and reducing it to powder, sufficient helium was evolved to show the helium spectrum clearly. Seeing that helium does not combine with anything at ordinary temperatures, and that this gas was extracted from the glass by mere mechanical powdering of the latter, it would appear that the occlusion is due to the mechanical driving of the gas into the glass, and not to any chemical combination.

Linnean Society, March 7.—Prof. W. A. Herdman, F.R.S., president, in the chair.—A series of specimens of *Nitella ornithopoda*, A. Braun, collected by the Rev. Canon Bullock Webster: H. and J. **Groves**. This rare species has only been found in a small district in the west of France, from Angoulême in the north to the south of Arcachon, and doubtfully in one locality in Portugal. The especial interest of the specimens exhibited, which were collected to the south of Arcachon in March and April, 1906, was that they represented gatherings of the plant from very different habitats, and showed great variations. The plants collected in shallow ditches were already in full fruit, while those from running water and from Lake Cazan were quite immature and so far sterile. Only a few specimens of this species have previously reached England, and the collection exhibited was probably by far the most extensive series of forms yet obtained.—The ornamentation of the frog tadpole, *Rana temporaria*, tracing the growth of golden spots which attain a maximum about the thirtieth day after the tadpole emerges from its gelatinous envelope: Miss N. F. **Layard**.—Decapoda captured during the 1900 cruise of H.M.S. *Research* in the Bay of Biscay, forming No. xi of the series of reports: S. W. **Kemp**. The majority of the specimens were larval adult Decapoda, being as a rule strong enough to swim out of an ordinary tow-net. A fine series of stages of *Acanthephyra purpurea*, A. M.-Edw., showed that, as Coutière predicted, this species hatches as a Zoæa, while the allied *A. debilis* leaves the egg in a "post-larval" condition with all its appendages formed. A curious feature of development was noted in that the rostrum and cornea, after considerable growth, undergo a sudden reduction, followed again by subsequent growth to the adult condition. The various stages, and those of a Caricyphus larva, were fully described and figured.—Colour changes in South African chamæleons, observed during the visit of the British Association to South Africa in 1905: Prof. L. B. **Poulton** and Dr. G. B. **Longstaff**.—The occurrence of *Spergularia atheniensis* and *Agrostis verticillata* in the Channel Islands: G. C. **Druce**.

Geological Society, March 13.—Dr. Aubrey Strahan, F.R.S., vice-president, in the chair.—A Silurian inlier in the eastern Mendips: Prof. S. H. **Reynolds**. The fragmental igneous rock is of two types:—(1) normal fine-grained tuff, from which in three localities more than thirty species of Silurian (probably Llandovery) fossils have been identified; the tuffs are seen at Sunnyhill to underlie the trap; (2) a coarse ashy conglomerate, the relation of which to the other rocks is obscure. Four possibilities as to the nature of this rock are discussed. It may be the basement-conglomerate of the Old Red Sandstone, an aqueous deposit belonging to the same igneous series as the associated trap and normal tuff, or an old river gravel deposited subsequent to the fossiliferous Silurian and prior to the Old Red, or it may represent the necks of the volcanoes from which the rocks were ejected. The last of these possibilities agrees best with the facts.—Changes of physical constants which take place in certain minerals and igneous rocks, on the passage from the crystalline to the glassy state, with a short note on eutectic mixtures: J. A. **Douglas**. The author describes the electrical apparatus employed. Powdered rock of known specific gravity is fused as often as required in a loop of platinum ribbon. The fused product is powdered, examined with the microscope, and then placed in a diffusion column. The diffusion column is sealed in a glass tube. Acid rocks were found to increase 6 per cent. to 10 per

cent in volume, intermediate rocks 5 per cent to 7 per cent, and basic rocks less than 6 per cent Of minerals tested, pargasite underwent the greatest expansion, albite gained 10 per cent, while in anorthite and leucite the increase was less than 4 per cent The melting points of the rocks and minerals experimented upon were found to range from 1260° C for rhyolite to 1070° C for Clee Hill dolerite The refractive indices of the glasses were determined in dense fluids An attempt was made to find experimentally the eutectic proportions of quartz and felspar A mixture of orthoclase and albite gave a melting point lower than those of either mineral taken separately

Royal Meteorological Society, March 20 —Dr H R Mill, president, in the chair —The exploration of the air Major B F S **Baden-Powell** Two classes of people are interested in the exploration of the atmosphere —(1) the meteorologists, who study it chiefly to find out about the weather, and (2) the inventors, who would utilise it as a highway of travel But these two are by no means rivals The attainment of their objects will be of mutual assistance to one another The aerial navigator will want to know all about the currents and the conditions of the air, while the meteorologist will derive the utmost benefit from the ability to visit any parts of the atmosphere There are three means now at the service of man by which he may ascend into these desirable regions, or may send up self recording instruments to probe the mysteries of the skies, viz balloons, kites, and flying machines The balloon, although at the time of its invention it was hailed with acclamation as promising the conquest of the air to man, yet it is now realised that this cumbrous and delicate apparatus is not capable of much practical application It is, nevertheless, useful (1) as an observatory for scientific investigation, (2) as a means of reconnaissance in war, and (3) as a most agreeable way of spending an hour or two in blissful peace and sublimity But recently great strides have been made in the improvement of the balloon in the way of providing it with engines and propellers so that it may be driven to any predetermined goal Twenty-five years ago the French Government made the first dirigible airship, and now it possesses one, if not more, that seems to be a really practical air vessel of war Count Zeppelin in Germany has also produced a machine which in point of size as well as in speed has beaten all records Going to the other extreme, we have small balloons now capable of attaining the greatest heights carrying self-recording instruments Such contrivances have recently ascended to the enormous altitude of 82 000 feet, or nearly sixteen miles above the surface of the earth Closely connected with this subject of *ballons sondes*, as the French call them, is that of meteorological kites These also have been much improved in recent years, and instruments lifted by kites retained by steel wires have actually ascended to a height of four miles Kites of a much larger dimension have also come into use during the last few years At Aldershot they have been regularly introduced into the service Men were first lifted by this means in 1895, in which year the lecturer made a number of ascents up to 100 feet high but improvements have gradually followed until now men have actually gone up to a height of 3000 feet, an elevation practically beyond the reach of rifle bullets and so high as to render the aëronaut almost invisible Major Baden-Powell, in conclusion, referred to a subject which, if it has not hitherto had any very practical results, yet promises to bring about perhaps more extraordinary changes in the life of man than have resulted from any other of the marvellous inventions of the nineteenth or twentieth centuries The flying machine has come, and it has come to stay During the last two or three years, not only have men been successfully raised off the ground, but have been able to sustain themselves in the air for half an hour at a time Very little more remains now to be done before we can say that man has veritably conquered the air

CAMBRIDGE

Philosophical Society, February 25 —Dr Hobson, president, in the chair —Some points in the anatomy of the peripheral nerves Dr B **Smith.** Several specimens were exhibited to show that the contour, size, and form of the nerve trunks of the body exhibited considerable variation, that these variations were associated with (1) the physical conditions of the tissue traversed by the nerve, (2) the displacements and strains to which the nerve trunk was subject, that the local enlargements which certain nerves exhibited were due histologically to (1) an accumulation of the intrinsic connective tissue in the nerve trunk, (2) the presence of numerous Pacinian corpuscles embedded in the nerve fibre bundles of the nerve trunk —An occipital vermian fossa and cerebellar vermian eminence Dr G F **Rogers.** A median occipital fossa 14 mm × 35 mm in the shape of a gutter was shown with a series of varieties ranging from a small triangular flattening at the base of the occipital crest through triangular fossae of increasing size up to the specimen noted above —The tendency to fusion shown by the suboccipital vertebræ Prof A **Macalister** A series of ankylosed cervical vertebræ in which there was exhibited a progressive coalescence of the several parts of the occiput and atlas, and of the axis and third cervical vertebra The stages ranged from a simple adhesion to a complete unification In one atlas there was a perfect neurocentral articulation between the pedicle and the axial odontoid process on one side —The range of variation in the navicular bone Dr M **Smith** An exhaustive investigation of the very large collection in the anatomy school results in the distinction of several well-defined varieties of the navicular bone —The histology of the early placenta in Semnopithecus Dr W L H **Duckworth** The anatomical department has received from Dr C Hose a specimen of the uterus of a *Macacus nemestrinus* in an early stage of pregnancy Microscopic examination of the placental area gives valuable and suggestive information as to the mode of connection of the maternal with the embryonic tissues in the earliest stages of placental formation showing in particular the fate of the uterine epithelial cells —A chemical test for "strength" in wheat-flour T B **Wood.** (See NATURE February 21, p 391)—The application of integral equations to the determination of expansions in series of oscillating functions H **Bateman.**

March 11 —Dr Hobson, president, in the chair —Reduction of carbon dioxide to formaldehyde (preliminary note) Dr **Fenton** Experiments were performed which demonstrated the direct reduction of carbon dioxide to formaldehyde in aqueous solution It was further shown that a similar reduction can be brought about indirectly, with formic acid as the intermediate stage —Dithioxanthoxalanil and its homologues S **Ruhemann** Thioacetanilide and its homologues react with ethyl oxalate in the presence of sodium ethoxide to yield coloured compounds, these, in composition, differ from the corresponding substances which the author previously obtained on using acetanilide and its homologues, by the replacement of two of their oxygen atoms by sulphur —Some observations on complex carbonates T B **Wood** and H O **Jones** The authors have investigated the solubility relations of potassium and copper carbonates, and determined the conditions under which the double salt $K_2CO_3CuCO_3$, crystallises out from these solutions —An optically active tetrahydroquinoline compound I **Buckney** Experiments have been made on a series of derivatives of tetrahydroquinoline containing a quinquevalent nitrogen atom, but at present the only compound that has been resolved is methyl allyl tetrahydroquinolinium *d*-brom-camphorsulphonate After repeated re crystallisation of the *d*-brom-camphorsulphonate from ethyl acetate and toluene, the less soluble portion had a molecular rotatory power of 195° in aqueous solution the value of $[M]_D$ for the basic ion consequently being −75° The more soluble portion gave a value for $[M]_D$ of 342° Hence the $[M]_D$ for the basic ion is +72° —A series of substituted bromanilines J R **Hill** These compounds were prepared in order to obtain from them two series of asymmetric nitrogen compounds by the addition of allyl and benzyl iodides Such series would only differ from those described by Miss M B Thomas and Mr H O Jones (Journ Chem Soc, 1906 p 280) by the presence of a bromine atom in the phenyl group In this way the change in the optical activity produced by increasing the weight of the phenyl group could be studied These

bromanilines were prepared by the bromination of the corresponding anilines, the series contains the bromophenyl and methyl groups with the ethyl, propyl, isopropyl, isobutyl, and isoamyl groups The isopropyl compound is a solid, the others are oils The bases were characterised by means of their picrates, and the quaternary compounds formed by addition of methyl iodide—Some new platinocyanides L A **Levy** In continuation of previous researches upon the fluorescence of platinocyanides (Trans Chem Soc, January, 1906), the author prepared uranyl, guanidine, and nitron platinocyanides, which were briefly described.—The resolution of salts of asymmetric nitrogen compounds and weak organic acids Miss A **Homer.** With a view to find out whether optically active nitrogen compounds could be used for the resolution of weak organic acids, that is, for those cases where a strong base is required, tartaric acid was treated with a solution of phenyl benzyl methyl isopropyl ammonium hydroxide prepared from the iodide, equimolecular quantities of acid and base being used A well-formed crystalline substance was obtained which on analysis proved to be the acid tartrate of the base used—A new coloured fluorescent hydrocarbon Miss A **Homer** A new hydrocarbon has been isolated from the products obtained by the action of aluminium chloride on naphthalene at 100° C, to which the formula $C_{24}H_{22}$ and the name tetramethyl erythrene have been assigned—Notes on the proportion of the sexes in dogs W **Heape.** The results show a remarkable similarity in the proportion of the sexes born by greyhounds, collies, and large dogs as a whole, while in terriers there is sufficient difference from the above to show that distinct racial variation occurs It is assumed from a variety of known facts that ova and spermatozoa are themselves sexual, and that the latest moment when the sex of the offspring can be determined is at the time of fertilisation—Preliminary note upon the presence of phosphorus in crystalline egg albumin Miss F G **Willcock** and W B **Hardy**—The natural units of mass length and time H C **Pocklington**—The variation of the absorption bands of a crystal in a magnetic field W M **Page.** An attempt is made to give a theoretical explanation of some observations made by M Jean Becquerel in the behaviour of the absorption bands of certain uniaxial crystals in a magnetic field

DUBLIN

Royal Irish Academy, February 25—Dr F A Tarleton, president, in the chair—The lower Palæozoic rocks of Pomeroy W G **Fearnsides,** Dr Gertrude L **Elles,** and B **Smith** The paper gives an account of the application of the modern zonal methods to a district made classic by Portlock so long ago as 1845 The beds developed are divided into the Desertcreat group, the Little River group and the Corrycroar group and are the equivalents of the Ashgillian, the Llandovery, and the Tarannon groups of Great Britain Of these the two lower groups are considered in detail, and are considerably subdivided The Desertcreat group rests unconformably upon the ancient hornblendic and granitic rocks to the north and is of a shelly or trilobite bearing type corresponding to the contemporaneous rocks of Girvan, its upper beds contain also a few graptolites and the interesting *Aeglina rediviva* The Little River group follows conformably, and like the rocks of Moffat is wholly graptolitic The rocks are much folded on the isoclinal plan, and the total thickness of the two groups mentioned can hardly exceed 600 feet Notes on the correlation with other areas and descriptions of certain interesting trilobites are appended The paper is illustrated by a map and sections

DIARY OF SOCIETIES

THURSDAY APRIL 4

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8—Steam Traps Gordon Stewart.

FRIDAY APRIL 5

GEOLOGISTS ASSOCIATION, at 8—On the Existence of the Alpine Vole, *Micratus nivalis*, in Britain during Pleistocene Times M. A. C Hinton

MONDAY, APRIL 8

SOCIOLOGICAL SOCIETY, at 4 30.—Research Meeting The Problems of Cities Prof Geddes.

VICTORIA INSTITUTE, at 4 30.—Plant Distribution from an Old Standpoint Dr H B Guppy

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Observations on Cotton & Nitrated Cotton H de Mosenthal.

TUESDAY, APRIL 9

ROYAL INSTITUTION, at 3—Wings and Aeroplanes Prof. G H. Bryan F R S

INSTITUTION OF CIVIL ENGINEERS, at 8—*Adjourned discussion*:—The Application of Hydro-Electric Power to Slate Mining: M. Kellow—Electrically Driven Winding Gear and the Supply of Power to Mines A H Preece

ZOOLOGICAL SOCIETY, at 8 30

WEDNESDAY, APRIL 10.

SOCIETY OF PUBLIC ANALYSTS, at 8—The Bacterial Estimation of Phenol and Cresol M Wynter Blyth and L. Goodban.—A New Method for the Estimation of Tartaric Acid Alfred C. Chapman and Percy Whitteridge—The Detection of Coconut Oil in Butter: E. Hinks.

ENTOMOLOGICAL SOCIETY, at 8—Odonata collected by Lieut.-Colonel Nurse, chiefly in North Western India Kenneth J. Morton

SOCIETY OF ARTS at 8.—Arts and Industries in Hungary in Ancient and Modern days L. Felberman

THURSDAY, APRIL 11

ROYAL INSTITUTION, at 3—The Birth and Affinities of Crystals Prof Henry A Mier, F R S

INSTITUTION OF ELECTRICAL ENGINEERS, at 8

FRIDAY, APRIL 12

ROYAL INSTITUTION, at 9.—Conservation of Historic Buildings and Frescoes Prof, A H Church, F R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8—An Engineer's Visit to Japan and Canada R W Allen

ROYAL ASTRONOMICAL SOCIETY, at 5

MALACOLOGICAL SOCIETY, at 8.—Notes on New Zealand Polyplacophora, with Descriptions of Five New Species: H Suter—Descriptions of New Mollusca from New Caledonia G B Sowerby—Some New Species of Drymaeus from Peru, Mexico, &c S I Da Costa—A New Species of Vallonia from India G K Gude.

INSTITUTION OF MECHANICAL ENGINEERS at 8.—*Continued discussion*—Petrol Motor Omnibuses W Worby Beaumont

SATURDAY, APRIL 13

ROYAL INSTITUTION, at 3—Studies in Magnetism Prof Silvanus P Thompson, F R S

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THURSDAY, APRIL 11, 1907

MECHANISM OF THE WORLD.

The World Machine. The First Phase, the Cosmic Mechanism By Carl Snyder Pp xvi+488 (London: Longmans, Green and Co, 1907) Price 9s. net.

IN this book the author purposes "to go back to the simplest beginnings of things—to the days when primitive man first learned to count, to measure, to time, and to weigh, and to mark out how his every step towards positive knowledge has been an advance toward mechanical conceptions of phenomena which must one day end in a mechanical conception of the whole." Two-thirds of the book are therefore devoted to a history of man's ideas about the construction of the universe, while the remaining pages give an account of the results of the investigations of the present day Among his predecessors the author mentions Pliny and Humboldt It would be unfair to blame him for not coming up to the high level of Humboldt, but it is unfortunate that he too often resembles Pliny in not having understood his sources properly, without resembling him in presenting his readers with a great mass of detail The narrative is very verbose, and does not clearly show how one idea or group of ideas has been developed from previous ones

The author has evidently not studied the original works of the heroes of science whose judge he has constituted himself, as he is anything but a trustworthy guide in the history of astronomy Among the historical works consulted he mentions Schiaparelli's memoir on the precursors of Copernicus, but he can hardly have read it carefully, since he repeats the old errors about Pythagoras and Philolaus having taught the heliocentric system Mr Snyder is not interested in those philosophers who did not know that the earth moves round the sun, and Plato and Aristotle are dealt with very severely Though he acknowledges that Plato knew something of geometry, he thinks that "the puerile phantasies with which his pages are strewn do not give us a very high idea of his powers of mind" Aristotle "cuts rather a sorry figure as a thinker," and the only philosopher of antiquity who finds favour in the author's sight is Demokritus, on account of his atomic theory

That the earth is a sphere the author imagines was undoubtedly known to the Egyptian priests, who communicated this discovery to Thales, and in several places it is hinted that the Egyptians and Babylonians knew a great deal more about the construction of the world than the Greeks ever did in after times This was the belief of Bailly (whom the author quotes among his authorities), but the discoveries of archæologists have long ago shown it to be devoid of the slightest foundation Among the Greeks, the author (or his source) fixes on a certain Bion, said to have been a disciple of Demokritus, but otherwise unknown, as the first to have worked out in detail the doctrine of the sphericity of the earth This is done solely on the authority of Diogenes Laertius, who says that Bion was the first to assert that there are countries where there is day for six months and night for six months That Parmenides and Pythagoras had announced the spherical form of the earth and divided it into five zones at least fifty years earlier is not mentioned

The various measures of the size of the earth are next dealt with, and it is stated that we do not know the exact value of a stadium It is, however, now quite certain that the stadium of Eratosthenes was equal to 157.5 metres, being the measure employed by the bematists or professional pacers, and that Posidonius used the same Their results for the circumference of the earth, 252,000 and 240,000 stadia, were therefore not very discordant, and the former was remarkably near to the truth Ptolemy, who gives 180,000 stadia, employed the official or Royal Egyptian stadium of 210 metres, so that he, in other words, simply adopted the value of Posidonius That Columbus thought India much nearer to Spain than it really is was therefore not caused by an error of Ptolemy in making the earth too small, but by his believing Asia to extend much further east than it does

If the author does scant justice to Eratosthenes in this matter, he certainly gives him far too much credit with regard to his idea of the distance of the sun We are told that, according to the "Placita Philosophorum," Eratosthenes gave this distance as 804 million stadia, a wonderful approximation to the truth So it would have been, but unfortunately the correct reading of the passage in question is 4,080,000 stadia, so that we need not trouble ourselves to find out how Eratosthenes came to know the distance of the sun so very accurately Neither was the knowledge of Posidonius on this matter very miraculous, for when he assumed the sun's distance to be 500 million stadia, it was a perfectly arbitrary assumption, in which he merely followed Archimedes In his "Arenarius," Archimedes had purposely made the circumference of the earth equal to three million stadia, in order to have large numbers to operate with, and the circumference of the solar orbit ten thousand times as great

No attempt is made to show how Aristarchus may have been led to suggest that the earth moves round the sun, but here, as everywhere else, the author fails to realise the state of science of past ages, and thinks that it "passes understanding" that Archimedes could accept the geocentric system The wonderful progress of mathematical astronomy, culminating in the work of Ptolemy, is quite ignored, and the picture of Greek astronomy presented by Mr Snyder is on the whole a very misleading one Passing to Copernicus, we find it stated that he discarded the system of epicycles, while the truth is that he had to employ them very largely, because he did not know the two first laws of Kepler The "third motion" of the earth assumed by Copernicus has

also been quite misunderstood As usual, the author is ready with his blame, and wonders that Lionardo da Vinci did not stand up for Copernicus. But as he died twenty-four years before the book of Copernicus came out, he may be held excused The same is the case with Kepler, who could not very well make use of Galileo's little book on mechanics written in 1594, since it was not printed until four years after Kepler's death Of Galileo we learn that he showed that the speed of a falling body increases with the square of the time (p 256) Had he really done so he would have deserved to be enrolled among the delinquents castigated by the author So would Newton, if he really had proved that the mass of a body may be calculated if we know the period and distance from the central body, or that gravity is less at the poles than at the equator (p. 261)

The author has succeeded better in the last hundred pages, which deal with stellar astronomy, the last chapter discussing the question of the probable "end of the machine" His own opinion is that all bodies will finally be congregated into a single mass, but he also sets forth the view of Arrhenius, that the matter of the universe follows a continual round of alternating aggression and dispersion

J L E D

THE MATHEMATICAL ASPECT OF SPECTROSCOPY

Vorlesungen über teoretische Spektroskopie By Prof A Garbasso Pp viii+256, illustrated (Leipzig Johann Ambrosius Barth, 1906) Price 7 marks

IN the printed report of the lecture delivered before the Royal Institution on March 30, 1906, on "Recent Progress in Magneto-optics," Prof Zeeman concludes with the following remarks —

"Maxwell has said, 'an intelligent student armed with the calculus and the spectroscope can hardly fail to discover some important fact about the interior structure of a molecule' I think this statement remains as true now as it was thirty-two years ago

"There can be no doubt, I think, that spectrum analysis, and especially the magnetisation of the spectral lines, will give us a clue to the inner structure of the atom

"I hope that I have succeeded in imparting to you this my conviction"

Now Prof Garbasso's book seems to us exactly to cover the ground contemplated by Prof Zeeman when he wrote these concluding remarks It is, in fact, a well-planned attempt to build up an electrodynamical theory of the phenomena of spectroscopy, using no more difficult mathematics than the ordinary calculus of mathematical physics

In spite of the fact that the word "electrodynamical" has gone out of fashion, and that it is more proper nowadays to say "electromagnetic," the old word is here retained as representing more correctly the spirit of the present book If the equations of the electromagnetic field are written down and the quantities in them are defined in the phraseology of the physicist, the study of these equations is rightly described as electromagnetism. By representing the quantities in question as generalised position coordinates and the corresponding generalised momenta in Lagrange's equations, the study is brought under the heading of dynamics. Inasmuch, however, as there is no hard and fast line of demarcation between the two methods, and it is a matter of convenience which interpretation is used, the name "electrodynamical" well describes the methods of a book in which both aspects are considered.

The book is divided into twenty lectures, and is based on a course delivered at the University of Genoa Of these, the first four form the first section of the book, and consist chiefly of introductory matter, namely, a summary of the principal phenomena of spectroscopy, a description of certain electromagnetic and electro-optical models and their application to the explanation of optical resonance, and a mathematical lecture dealing with the well-known theory of small oscillations, transformations of line, volume and surface integrals, and similar "auxiliary propositions"

The second section deals with Cauchy's theory of dispersion, Helmholtz's theory of anomalous dispersion, and a lecture on mechanical models of compound molecules, based on work by Dr Filippini, of Genoa, who uses various forms of compound pendulums for the purpose of representing the various degrees of freedom of the assumed molecules

The subject proper of the book, namely, the building up of mathematico-physical theories, commences with the eighth lecture, and occupies the two remaining sections of the book These two sections afford typical instances of what has been, and is likely to be, the most interesting and prolific field of research in dealing with complex physical phenomena To "explain" such a phenomenon we formulate some system, dynamical or otherwise, the equations of motion of which are capable of being integrated, and the integrals of which when interpreted represent effects similar to those observed The assumed system then constitutes a model of the given phenomenon Dr Garbasso has endeavoured to confine his treatise to the discussion of phenomena that are capable of being studied by means of models, adding that

"A theoretical exposition which does not take account of the properties or of the possibility of its model is for physicists no theory but only a chaos ('ein Unding')"

The models made use of in the third section are all electrical oscillators, each represented diagrammatically by two or more conducting spheres connected by wires For one-dimensional oscillations, simple oscillators each represented by two spheres are chosen; for three dimensions the author mainly employs compound oscillators having their conductors parallel to the three coordinate axes. These are, of course, simplifying hypotheses, but, as the author points out, for example on pp 124, 149, the character

the determinant is of a very high order in all but the simplest possible cases, and certainly the purpose of the investigation, that of judging the unknown from the known, is best served by keeping the mathematics as simple as possible. Even when this is done the author obtains theoretical confirmation of the known results regarding the spectra of metallic haloid salts (Lecture 14, § 1), Lockyer's long and short lines, and observations on the dissociation of the elements in the solar protuberances (Lecture 1, § 7, and Lecture xiv, § 6), Kayser and Runge's series of spectral lines, and the phenomena of surface colours ("Schillerfarben"), under which heading the colours of butterfly scales are discussed at some length, this application being illustrated by an excellent photograph of the scales of one of the "blues," in which the dimensions of the pigment granules are equal to the wave-length of blue light

This section deals, then, with the electromagnetic theory of spectroscopy of which Lecture 14 forms a general summary In the fourth and last section many of the same results are established in a different way, by what the author describes as the electrostatic theory This theory is based on the study of moving charges, and regards the molecule built up of electrified moving particles It is, in fact, the electron theory, and the first lecture contains a proof that in the cases considered the electromagnetic forces are negligible compared with the electrostatic ones The succeeding chapters deal with Dr Stoney's theory of double lines, J J Thomson's models of atoms, and conditions of stability with special reference to the periodic law The last lecture (Lecture 20) is a summary of the electrostatic theory, and contains explanations of the phenomena referred to above, based on this theory

In summing up, Dr Garbasso expresses the opinion that the electromagnetic and the electrostatic theories, and in some cases even mechanical models, are equally competent to account for observed phenomena The electrostatic method he considers to be the most complete, but the electromagnetic method possesses considerable advantages for teaching purposes, it possesses a peculiar heuristic value, and opens up the possibility of reproducing the electrical oscillations artificially

The book makes no claims to being a text-book, or in any way a complete account of all that might be said on the subject It contains, no doubt, many proofs that are open to criticism, but experience has shown that objections are very generally raised years after a book has been written, and very often on work which has been accepted unchallenged by a large number of readers The main points we have now to consider are whether the author has stated his case well and carefully, whether the book is calculated materially to help us in unravelling the many curious puzzles revealed by the spectroscope, and whether the methods adopted are the best suited to the objects in view, and on each of these points we pronounce judgment in the affirmative

G. H B

ORIGIN OF THE ENGLISH NATION.

The Origin of the English Nation By H Munro Chadwick Pp viii+352 (Cambridge The University Press, 1907) Price 7s 6d net.

THE title of this work really conveys a more accurate suggestion of its scope than the first sentence of the preface, which describes it as "an account of the early history of the English nation" There was certainly room for such a work, in which all the available evidence should be carefully considered, and Mr Chadwick has done this with the greatest minuteness In fact, his book suffers to some extent from over-minute discussion of questions which have at best a very faint bearing upon the main subject of his inquiry This is especially the case with the later chapters in the volume, such as that on the "Cult of Nerthus"

Another general criticism which might be made is that Mr Chadwick is rather too much given to the common, but very unsatisfactory, process of drawing a strong conclusion from a series of very weak premises, Unfortunately, much of the evidence relating to the Germanic conquerors of England during the time before the invasion is so fragmentary and contradictory that hypotheses can hardly be avoided It is therefore the more necessary that they should be used as sparingly as possible, otherwise they are apt to obscure the recorded facts In particular, it is of little service in the end to set modern supposition against ancient assertion, the former is at least as likely to be wrong as the latter, even when it appears to reconcile contradictions The author, for example, seeks to cast doubt upon the express statement of Bede that the invaders came from three nations, the Saxons, Angles, and Jutes On various grounds, such as similarity of language and customs, he comes to the conclusion that there is not sufficient evidence for separating the Saxons from the Angles, and that the invaders "belonged not to three but to two distinct nationalities"

That the distinction cannot be clearly perceived now does not prove very much, it may have been clear enough to themselves and to Bede It may even to some extent have become obscured through the migration to a new country, just as national differences soon tend to disappear in modern colonies Or the difficulties raised by Mr Chadwick may simply lie in the meaning to be attached to "nation" or "people" In Scandinavia of the tenth century we find four very distinct peoples who did not differ from each other in any essential respect It is no argument against the reality of the Saxon element that *Englisc* and *Angelcynn* became the usual designation of the language and the people Where no great difference was felt, the convenience of a common name would soon be obvious The use of national names is not stable enough to be valid evidence in doubtful cases The lowland inhabitants of Scotland in the fifteenth century called themselves Scots and their language English, and Snorri Sturluson evidently saw nothing contradictory in

making Norwegian kings speak "the Danish tongue" These instances show how readily the name of the Angles might efface that of the Saxons even at an early date

While such objections may be made to some of Mr Chadwick's arguments, the method he has followed in tracing the origins of the English people is a sound one He begins with what can be learned of the invading nations immediately after their settlement in Britain, and from this works back as far as possible into their previous history A necessary result of the method, however, is that as the inquiry advances the evidence becomes more scanty, and the use of conjecture more and more obvious For this there is no help, but it seems a little disproportionate to give only ninety pages to the English period and two hundred and fifty to the Continental, of which so little is known These ninety pages contain four chapters, of which the first gives a survey of England in the sixth century, showing the extent of the conquest at that date The West Saxon invasion, and that of Kent, are specially discussed in the following chapters, and the fourth is occupied with the question of the three nations referred to above It includes some useful tables of early linguistic variations, and remarks on these, together with an account of the difference between Wessex and Kent in respect of the various classes of the community and their wergelds

The very hypothetical character of Mr Chadwick's inquiry does not do full justice to the great mass of interesting matter which he has brought together A very wide range of reading and research underlies every chapter of it, and each point has evidently been the subject of much study and consideration Many of his views are highly suggestive, and may yet lead to more certain results In the meantime, the evidence produced does not seem sufficient to convict Bede of any essential error, or to modify in any important way the usual views on the subject

W. A Craigie

THE RAINFALL OF NORTH GERMANY

Die Niederschläge in den norddeutschen Stromgebieten By Prof G Hellmann In three volumes Vol i, pp vi+386+140, vol ii, pp viii+722, vol iii, pp viii+872 (Berlin Dietrich Reimer, 1906) Price 60 marks

DR HELLMANN'S three volumes contain a wealth of information relating to the rainfall and allied phenomena in the North German river basins The principal observations are elaborately reduced, and in many aspects very fully discussed The significance of this rainfall in its wider relation as part of the world weather, and, as such, its probable correlation with solar changes, are investigated with the advantage of well-marshalled data

The area specifically dealt with in the volume is extensive, consisting practically of the great plain which extends without interruption from the chain of mountain ranges in south Germany to the North Sea and the Baltic The direction of the river flow and the precipitation of the country are very largely determined by this chain of mountains, which is part of the great water-shed of Europe The conditions of the rainfall problem over such an area would seem to be fairly simple, and capable of being dealt with in general terms The local conditions, however, as is usual, exercise a considerable influence, the "actual" varying widely from any "mean"

The three volumes may be taken as a summary of the meteorological work of many years in the department of rainfall measurement within the district named Its fulness and painstaking completeness is such as is expected from the efficient State-supported meteorological organisation of Germany Much of the data is from the numerous and evenly distributed stations, daily returns from which are made immediate use of for short-date forecasting

The first volume is general, describing and discussing the data and results This volume is divided into five sections, of which the first, in dealing generally with the observation material and the manner in which it has been obtained, discusses the distribution of stations and the quality of the observations themselves The recognition of the influence on these of the type and position of the gauges used is of value Such considerations affect the credentials of the older observations, a knowledge of the standing of which allows the full length of the record to be used safely or to be rejected where untrustworthy A long meteorological record is sometimes, like the curate's egg, merely good in parts The ease of approximate rainfall measurement conduced to its early commencement, and very old records exist Observations made at Breslau (1717–1727) gave an annual mean of 576 mm, which does not differ greatly from the modern value of 567 mm A valuable bibliography of the history of rainfall measurement concludes this first part

The amounts of rain and their reduction and intercomparison are next dealt with The influence and value of smoothing curves by taking means is illustrated both by actual curves and by tables Means for several stations, for periods varying from five to forty-five years, together with the "greatest differences" in each set of means, are obtained and compared The standing of short-period means and the necessity of taking a long period to obtain a normal value become clear A valuable table of monthly seasonal and annual means, both actual and percentage of mean year, is given in the text for nearly 100 stations The distribution of rainfall in the year, from ten- and twenty-year means, is discussed and illustrated by curves for Konigsberg and Stettin Abnormal rains and thunderstorms are considered at some length, while material for further discussion is given in tables of great detail

The reduction of the data is further extended in the next section of the volume to the problem of the determination of the expectancy of greatest rainfall and the probability of the number of rainy days of definite intensity Various mean curves are used depending on periods of observation of from nineteen to forty-three years Snowfalls are dealt with in re-

lation to snowy days, and their number and distribution throughout the year are illustrated, as usual, with compact tables of mean values for a large number of stations Mean first and last snowfalls, here effectively tabulated, are important factors in the estimation of the climate of any place

To this point the work deals with general conditions and mean values drawn from the long and trustworthy records discussed. In the sequel, that most obvious fact about rainfall, its variability, receives attention. The outstanding and apparently abnormal features are discussed, and a very complete list of dry and wet seasons from 1851–1900 is here available for critical investigation The attempt to correlate these changes with larger variables, cyclic or otherwise, is a most important work The rainfall, considered in relation to the well-known sunspot period, seems to indicate that periods of maximum precipitation are bound up with maxima of sun's spotted area The author, however, is not able to consider these directly related as cause and effect, while he suggests that Sir Norman Lockyer's views as to the importance of prominences and allied phenomena may be nearer the true relation The reader is specially referred to Sir Norman Lockyer's "Report on Simultaneous Solar and Terrestrial Changes" as best setting forth the general relationship between these two classes of phenomena

The second and third volumes contain tables of data arranged under observing stations in the river basins

The work is a monument to the value of scientific organisation and industry, and illustrates the high worth of collecting long, trustworthy, and continuous meteorological records

OUR BOOK SHELF

The Zoological Record Vol xlii Being Records of Zoological Literature relating chiefly to the Year 1905. Edited by D Sharp (London Zoological Society, 1906)

WITH this volume ends, at any rate for the present the series of this invaluable work with which we have been so long familiar, for next year the amalgamation with the zoological section of the International Catalogue of Scientific Literature is to commence One effect of this change will be to make a radical alteration in the abbreviations employed for the titles of zoological serials, a change which, from the point of view of the working naturalist, is distinctly to be deplored Whether the new arrangement will give that relief to the recorders to which the editor alludes so confidently in the preface remains to be seen

In the main, the present volume follows the same lines as its predecessors, and displays the usual high level of excellence By a rigorous system of cutting down, it has, however, been found practicable to make a considerable reduction in the number of papers in the general section

Owing to the retirement of one old and experienced member of the staff, it has been necessary that a new recorder should undertake the sections dealing with reptiles, (inclusive of amphibians) and fishes, and it is unfortunate that the editor has not apparently realised that this new member of his team required more attention than the old stagers To allude to a tithe of the serious and misleading errors in these two sections would be impossible, and we can only indicate a few of the most glaring Geography seems a very weak point with this recorder In the fish section for instance, the Rio Negro is placed in Africa, while the eastern seas of the Russian Empire are included in Europe Arabia in the reptile section, comes under the heading of Africa, while in the fish section Muscat and Oman are placed in Asia "Ophidia" too, is so placed and printed on p 27 of the reptile record as to convey the idea that it stands for a country It should also have been explained that "Riu-kiu" is the Chinese equivalent of "Liu-kiu" or "Loo-choo"

As to misprints it might almost be said that their name is legion, but as examples it must suffice to notice *Epiorates* for *Epicrates*, *gandrvi* for *gaudryi*, *Hoodwell* for *Hordwell*, *Malaclemmys* for *Malacoclemmys*, and *Tyrranosaurus* (repeated in the list of new genera) for *Tyranosaurus* In the case of a large number of new species of reptiles the localities are omitted while many papers quoted in the title-list are not referred to in the subject index None of the genera included in the Percidæ really belongs to that group

The other recorders seem for the most part, to have done their work well, although it would have looked better if the somewhat long list of corrigenda to the mammal record had not been required

R L

The Principles of Horticulture A Series of Practical Scientific Lessons By Wilfred Mark Webb Pp 136 (London Blackie and Son, Ltd, 1907) Price 2s

THE experience of the author as a former teacher and demonstrator in the Essex County Council School of Horticulture has served him in good stead He puts a plant into the hands of the pupil shows him how to study it indicates to him what there is to be learnt from it both as to external form and internal function and having thus rendered help in the preliminary stages leaves the pupil to make himself master of further details by his own exertions

We rather doubt the advantage of beginning microscopical work at so early a stage, and should prefer to defer the investigation of the minute anatomy of a plant until the pupil has become familiarised with the facts of morphology The search for sieve-plates and companion cells might well be left until the pupil has familiarised himself with morphology and classification Stress is very properly laid on the importance of drawing, as every student soon finds the great help of sketches of even the roughest kind, provided that they show what the draughtsman saw or intended to see Accuracy of detail rather than artistic effect is what should be aimed at, and it is a matter of surprise to see the excellent representations which pupils make after very little practice The illustrations in the present book afford a good example of our meaning, they show what they are intended to show, though they are not pictures A list of the natural families, arranged according to the system of Engler, is given For the purposes of the beginner it would, we think, have been better to have picked out some dozen or score of the most important orders, and to have omitted a mass of detail not required by the average student and not full enough for those who desire more complete information

A section is devoted to the insects which prey upon plants, and to the measures to be taken for the destruction of these pests, as well as of fungi That the book is up to date may be gathered by the references to Mendelism and De Vries

A copious index is given, as well as hints as to the way in which examination questions should be answered

A little more information as to the "reason why" of digging, watering, striking cuttings, and other garden operations would have increased the value of the book, which nevertheless is one which can confidently be recommended to the attention of all those interested in gardening

Dr Schlich's Manual of Forestry Vol iv Forest Production By W R Fisher Being an English adaptation of "Der Forstschutz," by Dr Richard Hess Second edition Pp xxiii+712 (London Bradbury, Agnew and Co, Ltd)

This volume is the second edition of Prof Fisher's "Forest Protection," and is uniform with the third edition of vols i, ii, and iii of Dr Schlich's "Manual of Forestry" The book is an English adaptation of Dr Hess's "Forstschutz," that is, it is not a mere translation, as the author has exercised discretion in his selection of material in order to make the book more adapted to the use of British and Indian foresters New illustrations have also been added which are not in the German edition The subject of forest protection is of immense importance, and covers a wide field of knowledge, practically including every branch of scientific sylviculture The author has arranged and presented the various protective measures to be adopted against inimical agencies both in the organic and inorganic worlds in a very clear and interesting manner The volume also contains a useful index at the end Prof Fisher has done valuable work by rendering available to student and forester a vast store of information which has hitherto been accessible only to a few The book is one which we can warmly recommend to all those who have forests or trees under their charge

The Essentials of Histology, Descriptive and Practical By Prof E A Schäfer, F R S Seventh edition Pp xi+507 (London Longmans Green and Co, 1907) Price 10s 6d net

The fact that this volume has reached its seventh edition shows conclusively that it supplies a want The features of the present edition are the introduction of colouring in the illustrations and a considerable increase in the part devoted to the nervous system In this portion practically a new set of illustrations appears, which can only be described as admirably calculated to indicate the salient points which the elementary student must be familiar with Either for the purely scientific or for the medical student this book will continue to be of the highest value

Actualités scientifiques By Max de Nansouty Pp 361 (Paris Schleicher Frères, 1906) Price 3 50 francs

The general character of this annual publication was described in noticing the issue for 1905 in Nature of November 23, 1905 (vol lxxiii, p 76) The short essays on scientific subjects of current interest range over most branches of science and should be useful as reading exercises in French classes in schools where the pupils also learn something of science

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications]

A Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle.

The device about to be described enables us to illustrate to a class the behaviour of different types of radiating bodies when introduced into a flame, and will be found especially useful in explaining the remarkable luminosity of the incandescent mantles used in modern gas-lighting. It is, of course, not intended to explain the mechanics of radiation, but merely to enable us to describe certain phenomena in terms of easily grasped notions

Students are told that the more powerfully a body absorbs the more powerfully will it emit when heated, this relation holding for every individual wave-length Black bodies, then, give out the most light when heated The fact that a white block of lime is far more luminous than a carbon rod when heated in the oxyhydrogen flame is not usually cited in support of this law, while the fact that the most luminous body of all, the Welsbach mantle is also quite white, is equally unsatisfactory as an illustration, for white bodies are in reality transparent, that is, they are made up of masses of small transparent particles, and transparent bodies ought not to emit at all It is, of course, necessary to define just what we mean by transparency in this case, and it may be well to consider first a somewhat analogous case The absorption which is accompanied by high emissivity is true absorption, and not selective reflection, which is sometimes confused with absorption A highly reflecting polished metal surface is a poor radiator, but by properly constructing its surface we may give it the power to absorb and emit A bundle of polished steel needles with their points all turned towards the source of light reflects scarcely any light at all, the rays undergoing multiple reflections between the conical ends of the needles Such a bundle of needles should emit much more powerfully than a polished steel surface, and it is easy to see just why it should do so Each needle seen end on, sends not only emitted light to the eye, but reflects rays coming from its neighbours The surface formed by the points of the needles can be regarded as an absorbing surface, which absorbs in virtue of its structure, it is analogous to the hollow "black bodies" with which we are now familiar. The point which I wish to emphasise is that such a surface which absorbs not at all in virtue of its molecular nature, is also a powerful radiator, the mechanism by which its radiating power has been increased being as indicated above

Suppose, now, we take a perfectly transparent body, which, like a perfect reflector, has no emitting power A bead of microcosmic salt (sodium pyro-phosphate) heated in a blast lamp is a good example Though the platinum wire which supports it glows with vivid incandescence, the bead remains perfectly dark A glass bead, however, emits a good deal of light, doubtless from the fact that its transparency is much less at high temperatures, a very common behaviour of transparent substances. The microcosmic salt on cooling becomes traversed by hundreds of cleavage planes, which give it a milky appearance On re-heating it it emits light strongly, until it finally fuses into a transparent drop, when it instantly becomes dark again The reason for this behaviour is not quite so apparent as in the case of the needles In fact, I am not quite sure that I understand it at all. Quartz behaves in the same way A drop of clear fused quartz, heated in the blast emits little or no light, but if it contains spots made up of an emulsion of quartz and air, these spots emit strongly In other words, an opacity resulting from a pulverisation of the transparent medium seems to be accompanied with a strong emitting power Apparently we cannot apply the same reasoning as in the case of the needles, and it looks rather as if the radiation was largely a surface effect If this is so, it is obvious that an

increase of the surface, by enclosures of air, will increase the radiating power. It is my intention to make some measurements of the intensity of the light radiated from the ends of long and short cylinders of red-hot glass

The hydraulic analogy of radiating bodies which we will now consider occurred to me during a lecture on radiation, and proved quite useful in explaining the different behaviour of various types of radiators

The radiator is represented by a tall hollow cylinder, open at the top and closed at the bottom, provided with a number of outflow pipes of different sizes as shown in Fig 1. Water flows into the cylinder at a certain definite rate from a horizontal pipe or flume, the height of which above the base of the cylinder (T_1) represents the temperature of the flame Obviously the level of the water in the cylinder will rise until the rate at which the water flows out exactly equals the rate at which it flows in This height (T_1) is the temperature which the radiator acquires in the flame The jets of water which issue from the tubes represent radiation of different wave-lengths, the small jets representing the short waves

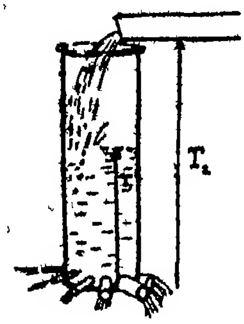

FIG. 1

We will first suppose our hydraulic radiator to represent a black body, say a lump of carbon In this case all the pipes at the bottom are wide open and we have the maximum outflow of all wave-lengths for any given temperature, *i e* for any given height of the fluid within the cylinder If we take the cylinder empty and plunge it into water, jets will squirt into it through the pipes that is, it is a perfect absorber for all wave-lengths With all the pipes open, however, the level of the water within the cylinder will not rise to any great height, owing to the limited rate at which water flows in from the horizontal pipe This means that the lump of carbon in the flame does not rise to a very high temperature because it radiates energy at a high rate At the low temperature there is comparatively little visible light in the radiation, for the shorter waves only appear in quantity at high temperatures We can imitate this condition in our hydraulic model if we choose by putting valves on the inside of the tubes, those on the small tubes opening only at high pressures

To make our model imitate the bead of microcosmic salt we plug up all the pipes The cylinder now represents a transparent body If immersed in water it absorbs nothing through the pipes, and no matter how high the level of the water rises in it there is no emission of fluid, in other words, no radiation The body rises in temperature until the temperature is equal to that of the flame, but there is no radiation Take next the case of the lime in the oxyhydrogen flame It is a partially transparent substance, and we can imitate it by plugging the tubes with glass beads or cotton Owing to the lesser rate at which the water now flows out through the tubes the level rises much higher than when the tubes are all open, and owing to the greater pressure (temperature) we have liquid jets through the small tubes (short wave-length radiation) The inferiority in the emissivity is more than made up for by the higher temperature which the body can acquire. We are now ready for the Welsbach mantle

It has been conclusively shown by Rubens that the peculiar brilliancy of the thorium mantles, caused by a small trace of cerium, is due to the fact that the cerium makes the thorium selectively absorbing for the short waves at high temperatures If we wave a Bunsen flame over a mantle in a brilliantly lighted room, it will be seen to turn yellow at a temperature a little below a red heat In other words, it becomes a strong absorber for the short waves It is, however, transparent for the long waves, consequently it does not emit energy at anything like the rate at which a black body does, and in consequence can rise to a high temperature in the flame, exactly as a pure thorium mantle Its band of absorption in the blue region enables it to pour out visible radiations nearly as powerfully as those which a black body at the same temperature would emit, hence its enormous brilliancy Our hydraulic model, with its tubes all plugged with cotton, represents the mantle of pure thoria, while to transform it into the Welsbach mantle we have only to pull out the porous plugs from some of the smaller tubes. In this condition, owing to the impeded flow in the large tubes, the water will rise in the cylinder to a great height, and we get very powerful jets from the small tubes which we have opened, much more powerful than in either of the previous cases considered Of course, with all the tubes open we could get equally intense small jets if we poured the water in at the top at a sufficient rate There is a limit to this rate, however, for it is obvious that the rate at which the water is poured in at the top corresponds to the rate at which the flame can pour energy into the radiating body, a circumstance which depends on the conductivity of the body for heat and other things

It is not necessary to make the hydraulic apparatus, of course, for its action is so easily understood that a diagram answers every purpose Its utility lies in the fact that it fixes in the mind of the student the behaviour of different types of radiators when plunged into a flame

It could be made, perhaps, to illustrate the displacement of the point of maximum energy in the spectrum which accompanies a rise in temperature, but it is doubtful whether any such complications would prove beneficial It seems best, on the whole not to try to illustrate too much with it, as its relation to a radiating body is at best rather far-fetched R W WOOD

Johns Hopkins University, Baltimore

Retardation of Electroscopic Leak by means of recognised Radio active Substances

IN a communication made to the Royal Society on April 5 1906, and subsequently published in the "Archives of the Middlesex Hospital," vol vii I described certain experiments which I regarded as showing that substances exist which retard the leak of an earthed metal electroscope I further asserted that an aluminium plate which had been kept in proximity to, but not in contact with, uranium, thoria or pitchblende also retards the electroscopic leak This retardation does not necessarily occur immediately after introduction of the modified aluminium plate into the electroscope for after proximity to thoria there is a period, lasting three or four days during which the leak is accelerated and after proximity to radium I failed to find any evidence of retardation whatever My results were received with scepticism, except by Sir William Ramsay, who had independently observed the same phenomenon in his laboratory It is impossible to occupy your space with details but it may be stated that gold-leaf electroscopes made of ⅛ inch lead were used, that the earthing of electroscopes and aluminium was complete that effects of induction and alteration of capacity of the electroscope were eliminated, and that the general conditions were kept as constant as possible

Since reading the paper I have repeated the experiments in the most stringent way of which I am capable in a pathological laboratory, and have obtained identical results Further, using the same apparatus, I have exposed the aluminium plates to X-rays for a period of three hours, and have found a complete absence of any change in the rate of leak, whether in the direction of retardation or of acceleration Full details of these experiments will be published in the forthcoming number of the Archives of the Middlesex Hospital Below I give the salient points of an experiment which was carried on continuously from August 10 to December 24, with the exception of intervals August 27 to September 11, and September 19–30, during both of which the electroscopes were left undisturbed The values given represent percentages of the mean leak of the electroscope during twenty-four hours under normal conditions corrected by the leak of the control electroscope on the day for which the observation is given

Lowest corrected percentage during period August 10 to

October 12 (standardisation period) = 84.8 On nine out of thirty five observations during this period the corrected percentage was below 90

Lowest corrected percentage during two blank experiments, each lasting twelve days = 89.1 On one out of twenty observations during these two periods of blank experiment the corrected percentage leak was below 90

Lowest corrected percentage during period November 7–17 after two days proximity of the aluminium plate to pitchblende = 81.9 On ten out of eleven observations during this first period of true experiment the corrected percentage was below 90

Lowest corrected percentage during the period November 21 to December 24, after a two days' re-approximation to pitchblende = 79.5 On thirty-one out of thirty-five observations during this second period of true experiment the corrected percentage leak was below 90

W S LAZARUS BARLOW

Cancer Research Laboratories The Middlesex Hospital, W, April 3

Atmospheric See Saw Phenomenon and the Occurrence of Typhoon Storms

IN January last there was a very noteworthy barometric change agreeing in a high degree with the results of those synodal pressure periods which have been affirmed for European latitudes by the statistical investigations of two German meteorologists, Captain K Seemann and Dr G Meyer These results require high pressure at the time of the first quarter and low pressure at the time of the full moon, especially in the months from September to January Last January was also in a synodal respect marked by its elliptical character, so it agrees accurately with those requirements, the first date (January 21) nearly coinciding with a record of high pressure in northern, central, and eastern Europe, and the latter date (January 29) with a decidedly low pressure The conditions on the following first quarter (February 20) were completely reversed, for on this date there was a remarkable record of low pressure in the above parts of the earth atmosphere

This direct reversal of the pressure conditions of January was sufficient to excite the suspicion of a kind of see-saw phenomenon This suspicion has been confirmed by a synoptic investigation of the barometric conditions over the whole earth, so far as information is at present available The isobar of 760 mm surrounded on February 20 the greater parts of Europe the North Atlantic, and North America The whole area contains more than 50,000 000 square km, nearly one tenth of the whole surface of the earth, but it soon became possible to prove that an area of very high pressure also existed on February 20 This area had its centre over Transbaikalia The weather report of St Petersburg records on that day barometric observations from Chita of 789.8 mm from Nerchinsk of 765.0 mm and from Irkutsk of 783.4 mm In Chita and Nerchinsk the barometer was ascending from February 19 to February 20 It is possible, too that those tabulated barometric readings were too low In the same reports the maps of January 22–23 show areas of more than 800 mm but in the tables the readings of all stations, including the stations situated in those areas, are below 800 mm

This record day of high pressure, examined in the same manner shows a much more widely spread area of pressure over 760 mm than the area in which the readings of February 20 were under 760 mm The high-pressure area of January 23 seems to contain nearly the whole of Europe, the greater parts of Asia and America, the Northern Atlantic, the Chinese and Indian Seas Mostly below 760 mm apparently were the continents of Australia and Africa and south western Asia The whole area of high pressure contained about 157 000 000 square km nearly one-third of the surface of the earth

To the east of the Japanese islands from Formosa to Yeso, there were some depressions below 760 mm and 763 mm which had shown on the previous days more or less a typhoon character Zikawei recorded on January 23 an area below 754 mm between 22° and 30° N lat and east of 140° E long The very lowest barometric reading of the same day is recorded—so far as there is information—in South Argentina, C Virgenes in N E Tierra del Fuego showing a pressure below 750 mm

The atmospheric conditions prevailing on January 23 over the N W Pacific point to a possible connection of the pan-atmospheric see-saw phenomenon with typhoon storms. Indeed, the extreme depressions of these storms seem able to exercise an influence on the common atmospheric situation Further, the most frequented typhoon areas nearly coincide geographically with the two areas of contrary see-saw, as these areas are ascertained by my method of qualitative analysis of some barometric diagrams The two areas are the Indo-Australian and the Central American regions

I feel bound to publish these preliminary notes first in an English journal, because my researches in the main were made possible by the materials which the Meteorological Office in London liberally placed at my disposal

WILHELM KREBS

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Early Reference to Red-light Treatment of Small-pox

THE use of blue light as an anæsthetic and red light to prevent marking from small-pox has aroused some interest within recent times The subjoined extract is from a footnote in Miss Strickland's history of Queen Marguerite of France, and was first published in 1839 According to this quotation from Gaddesden, the red-light treatment would seem to have been known in the days of Edward the First

ALFRED SANG

Garland Nut and Rivet Co, Pittsburg, Pa

WHILE music and sculpture had attained some degree of perfection in England at this time, other arts and sciences were in a strange state of barbarous ignorance The earliest notice of medical practice is to be found, at this era, in the Latin work of Gaddesden, physician at the court of Queen Marguerite This learned doctor, describing his treatment of Prince Edward in the small-pox thus declares his mode of practice —"I ordered the prince to be enveloped in scarlet cloth, and that his bed and all the furniture of his chamber should be of a bright red colour, which practice not only cured him, but prevented his being marked" More by good luck than good management, assuredly, it may be supposed that Gaddesden wished to stare the red inflammation of the small-pox out of countenance, by his glare of scarlet reflections' He adds in his Rosa Anglorum that "he treated the sons of the noblest houses in England with the red system, and made good cures of all" In this childish state was the noble art of healing at the court of Marguerite

The Lyrid Meteors

THERE are other nights besides the usual ones of April 20–22 on which it is desirable that a watch should be maintained for these meteors, and in the present year there are three dates that call for special attention in this respect, viz those of April 14, 18, and 23, as from calculations made by the present writer showers become due on these nights though it will not be possible, owing to the hours of their occurrence, to observe them all from the same station Probably, so far as direct observation is concerned, the general Lyrid maximum will fall on the night of April 23, as its special periods of activity will favour more observers than in the case of the other two displays

The following are the computed times of the various maxima of the anticipated showers —

April 14 7h and 9h 30m. G M T
April 18, 3h 30m and 7h G M T
April 23, 8h 30m and 14h G M T.

The moon will hinder observations most on the night of April 23 but if this night turns out clear, some fine meteors will probably be observed

JOHN R HENRY

GYROSCOPIC APPARATUS FOR STEADYING SHIPS

IN our account of the recent meeting of the Institution of Naval Architects (NATURE, March 28, p. 522) reference was made to the paper read by Sir William White in which he gave particulars of certain experiments carried out on the estuary of the Elbe by means of a torpedo-boat, the *Seebar*, in which Dr Otto Schlick's gyroscopic apparatus was fitted. In our report of the meeting we stated that we should return to the subject, and this we now proceed to do.

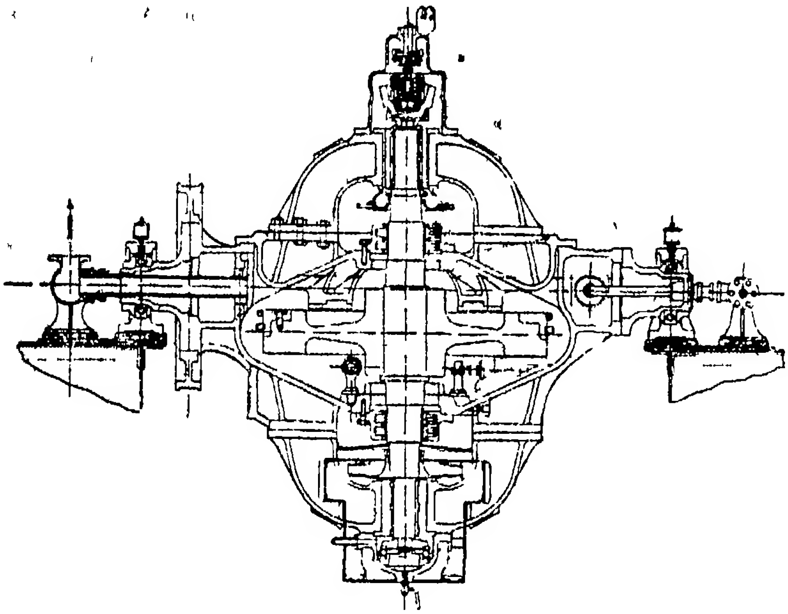


FIG. 1.—Details of steadying apparatus on s.s. *Seebar*. Scale about 1/25th full size.

It may be remembered that three years ago Dr Schlick read a paper at the spring meeting of the same institution on the gyroscopic effect of fly-wheels on board ship, and at the same period he illustrated, by means of models, the system of steadying vessels which he had brought forward. The models were, as Sir William White pointed out, of small inertia compared to the inertia of the gyroscopes mounted in them, and the steadying effect was, therefore, more marked than it would be under the conditions of ordinary working with ships or boats. In these circumstances it is perhaps hardly surprising that a good many persons connected with seafaring looked on Dr Schlick's apparatus as outside the region of useful application; in fact, it would not be an exaggeration to say that the idea was largely considered to be a very pretty scientific "fad."

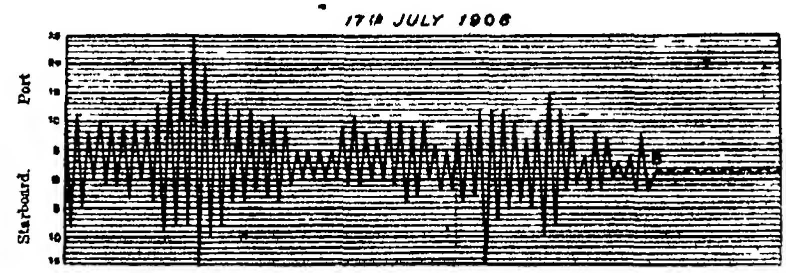


FIG. 2.—Diagram of Oscillations of s.s. *Seebar*.

Dr Schlick, though a man of science, is by no means a "faddist", as the position he holds in the German mercantile marine, and the substantial contributions he has made to the advancement of marine engineering practice sufficiently show, and he determined to prove the soundness of his theoretical investigations by experiment on a practical scale. To this end he acquired the *Seebar*, formerly a first-class torpedo-boat, 116 feet long, 11·7 feet wide, 3·4 feet draught, and of fifty-six tons displacement. Her metacentric height was 1·643 feet, and her period of oscillation (double roll) 4·136 seconds. Into this vessel was fitted the gyroscopic apparatus, of which we give a sectional elevation in Fig. 1. The following are the main particulars:—the outside diameter of the fly-wheel was 1 metre, the weight, without the spindle, 1106 lb., and the peripheral velocity at which it was run 274·8 feet per second, the number of revolutions being 1600 per minute. The fly revolved on a vertical spindle, and was of forged steel; it was enclosed in a cast-iron case, the latter being supported by two hollow trunnions, the common axis of which was in a 'thwartships direction, as shown in Fig. 1. It would have been preferred to have used electric power to revolve the fly-wheel, but as generating machinery was not fitted it was determined to use steam direct, and for this purpose blades were fitted to the periphery so as to work the fly-wheel as if it were a turbine, steam being admitted through the hollow trunnions. For this reason the peripheral speed was less than it would have been had electricity been the motive power and the weight was consequently greater for the production of an equal gyroscopic effect.

It will be assumed for the purpose of this description that the principle of gyroscopic action is known so far as it is generally understood, but those who wish to refresh their memories on this matter would do well to refer to Dr Schlick's paper in the Transactions of the Institution of Naval Architects for 1904. The common centre of gravity of the whole apparatus was, in the *Seebar*, below the axes of the trunnions with the vessel at rest, and the spindle therefore vertical. On rolling motion being set up the spindle would be free to become inclined from the vertical in a fore and aft direction, and, as rolling proceeded, the gyroscopic effect of the fly-wheel would produce longitudinal oscillations of the apparatus having a period depending upon the distance of the centre of gravity below the axes of the trunnions and upon the moment of inertia of the apparatus

about the axis The amplitude of oscillation of the gyroscope, as Sir William White proceeded to point out, depends upon many conditions, among which the period of oscillation and its ratio to the period of rolling of the vessel are important

In order to utilise the gyroscopic effect in checking rolling it is necessary to have a means of braking the apparatus so as to check movement on its trunnions and the rotary motion of the fly-wheel To control the swinging motion a simple band-brake was fitted, the drum for which is shown on the left of Fig 1 In addition to this a socket was fitted on each side of the gyroscope casing below the fly-wheel, the braking effect being supplied by hydraulic power and regulated by a valve With the casing held by the brake the gyroscope would have no effect on the rolling motion, but on the friction band being loosened the casing would oscillate on its athwartship trunnions, and the gyroscopic action would come into play Sir William White says that, when standing upon the deck, which maintained a practically horizontal position, the vessel heaving vertically, it was curious to notice that though the gyroscope might be oscillating longitudinally the impression was conveyed that the vessel herself was pitching

Still-water rolling experiments were made with the *Seebar*, rolling being set up by the crew running from side to side With the gyroscope fixed the period of a complete double roll was found to be 4 136 seconds When the fly-wheel was running at 1600 revolutions per minute, the period was six seconds The boat was next hove down by a crane to an inclination of 10° to 15° from the vertical and when let go the successive extreme inclinations were noted until they fell to about ½°

The still-water rolling experiments strikingly illustrated the enormous extinctive effect of the gyroscope as shown by a diagram given by the author of the paper Selecting two experiments for illustration, it was found that with "an initial angle of inclination of 10° with the gyroscope at rest 20 single oscillations took place before the extreme inclination to the vertical was reduced to half a degree, whereas the same amount of extinction was obtained with little more than two single oscillations when the gyroscope was free to oscillate and the fly-wheel was rotating at 1600 revolutions per minute "

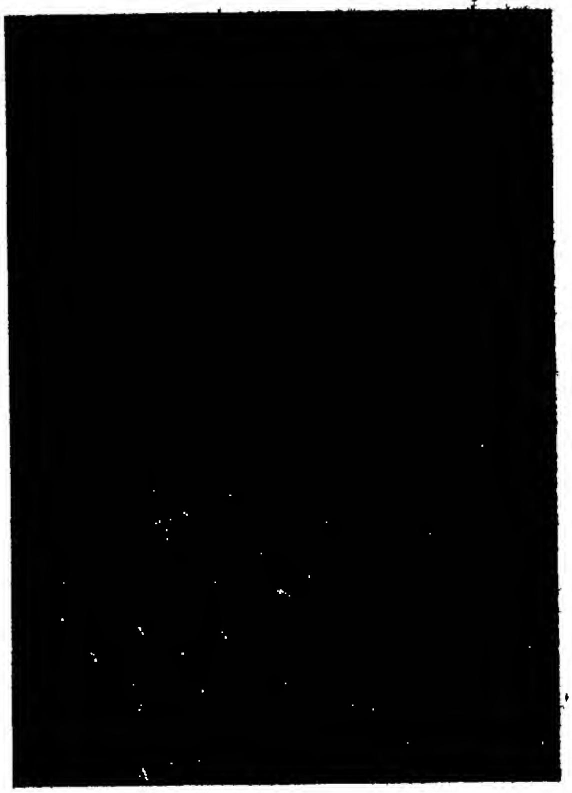
In Fig 2 we reproduce from Sir William White's paper a graphic record of rolling experiments made with the *Seebar* off Cuxhaven The point marked B denotes the time when the brake band was released, the gyroscopic wheel becoming free to swing on its trunnions, and the extinctive forces coming into action The revolutions were 1600 per minute, and as will be gathered, the practical result was to extinguish the rolling motion almost immediately although the vessel was naturally still subject to heaving motion The inclinations were insignificant, varying from about ½° to 1°

Sir William White in his paper discussed the further application of the apparatus to war vessels, and though he did not commit himself to any definite opinion, it may be said that the impression given was decidedly of a hopeful nature In connection with this subject the experiments of Sir John Thornycroft with his steam yacht the *Cecile*, and those of the late Mr Beauchamp Tower with his hydraulic steady gun platform controlled gyroscopically, will doubtless be remembered Particulars of both series of investigations are to be found in the Transactions of the Institution of Naval Architects

G R Dunell

BRITISH NESTS AND EGGS.[1]

THIS handsome and exquisitely illustrated volume (which is practically a new work, so greatly does it exceed its predecessor in bulk and in wealth of illustration) makes its appearance, no doubt purposely, at an opportune time, and if it induces but half-a-dozen collectors in the coming season to devote their attention to photographing the nests of our native birds in place of robbing their eggs, it will have done a great service to British ornithology. According to the letter of an admirer quoted in the preface, such a conversion has already taken place in several instances as the result of the Messrs. Kearton's previous works, and an extension of the new practice may therefore be confidently awaited. Mr Kearton observes that "it is a curious kind of morality that will scorn to steal from the individual



Ptarmigan on Nest From "British Birds' Nests"

and yet rob the community without compunction. Wild birds are national property, and no individual has a right to harm one of them without the sanction of the law to do so " Although this is, no doubt, to a great extent true, it must be remembered that by nature we are all essentially hunters and spoilers, and as many of us, at any rate, have not yet fully imbibed the socialistic spirit, it would not do for the present to be too hard on the egg-collector if he conducts his operations with moderation *Festina lente* is an admirable motto in this and many other matters.

As regards the book itself, a critic is frequently embarrassed as to what he should write from the intrinsic badness of the work set before him, in the present instance the reverse of this is the case, and

[1] "British Birds' Nests, How, Where and When to Find and Identify Them By R Kearton New edition, revised and enlarged. Pp xii+520, illustrated (London Cassell and Co , Ltd., 1907) Price six net

the reviewer scarcely knows how to control his pen so as not to appear unduly laudatory To say that the book is practically perfection is a mild way of putting it, for, as a matter of fact, it is one that can never be equalled or rivalled so long as the copyright of its illustrations holds good, since no other man is likely to undertake the labour and expense necessary to produce a similar series of pictures from nature, even if he had the energy and patience necessary to the task. How great a debt ornithologists and bird-lovers generally owe to the Messrs Kearton (for a large number of the photographs have been taken by the author's brother, Mr Cherry Kearton) it is, indeed, impossible to estimate, and a part of their reward, at any rate, must consist in the pleasure they afford to, let us hope, an ever-widening circle of readers.

Of the photographs of nests and eggs, as well as of those of the parent birds, it is impossible to speak too highly, and where all are on such a high level of excellence it would be almost invidious to select any for special commendation The one here reproduced has been chosen on account of its size rather than from any other consideration The plates of eggs are admirable examples of the best style of three-colour process Taken as a whole, the volume (which is a marvel of cheapness) will probably prove the most attractive natural history book of the year

THE ORIGIN OF "BOTTOM WATERS" IN THE NORTHERN SEAS

A SERIES of valuable tables and charts, in which the results of a great series of observations made in 1901 by Captain Roald Amundsen in the Arctic Seas are summarised, is contained in a monograph recently published[1] These observations are supplemented by, and compared with, results published by other observers, chiefly Russian and Norwegian, and as a collection of facts the little volume is certain to prove of great value to all students of oceanography Dr Nansen's main purpose in the discussion of the observations has been the scientific explanation of the origin of the intensely cold and heavy "bottom waters" found in the basins of the Norwegian seas and North Polar Ocean In discussing the scientific results of the Norwegian North Polar Expedition of 1893–6, Nansen had already dealt with this subject, and reached the provisional conclusion "that the cold bottom water of the Barents Sea is divided into two portions, the northern cold water coming from the sea to the North, North East, and East; and the southern cold water having two or three sources, namely bottom currents from the East and North East, and the surface of the sea itself which is cooled during the winter" In the light of more recent and extensive observations, Nansen has revised his opinion, and puts forward a different explanation of the origin of bottom water This explanation accords with the facts observed, and may be briefly summarised

The conditions required for the formation of bottom water are that near the surface water shall be found having a salinity of about 34 9 per cent, and that during winter this water may be cooled down to $-1°3$ C or $1°4$ C. Its density may thus be between 28 11 and 28 13, and possibly greater, so that it becomes sufficiently heavy to sink The assumed salinity of surface water Nansen thinks will only exist in places where Atlantic water has mixed with Arctic water Further, he considers that when bottom water is being formed there must be no rapid horizontal circulation which would bring in new supplies of relatively warm water As the surface water becomes heavier it sinks, and will be replaced by somewhat warmer water of higher salinity, which in its turn will be cooled until it becomes heavier than the previous surface water, when it will sink still deeper, and be replaced by warmer water of still higher salinity from below The uppermost strata will by this process be gradually increased in salinity, and approach that of the bottom water—about 34.9 per cent The depth of vertical circulation will increase until it reaches down into the typical bottom water, and at that stage all strata from the surface downwards will have attained nearly uniform temperature, salinity, and density Subsequent cooling at the surface will produce water so heavy that it may sink far down into the bottom water, or even to the bottom of the sea

The heaviest sea-water of which Nansen has any knowledge was found at a depth of 120 metres—8 metres above the bottom—off the coast of Nova Zembla in May, 1900, the temperature of bottom water has in some cases approached $-2°$ C with a salinity exceeding 35 per cent and a density of 28 33 The observations made extended to depths of 3000 metres, where the temperature was $-1°1$ C Amundsen reached 2000 metres, at which the temperature was $-1°3$ C

The circulation of bottom water in the Norwegian Sea Nansen describes as follows —The bottom water is chiefly formed and sinks towards the bottom during the winter and spring in the regions between 73° and 76° north latitude, and between 4° west longitude and 4° east longitude From this region it moves along the bottom and spreads out laterally, producing cyclonic movements in the deep strata of the Norwegian Sea During this circulation the bottom water is slowly heated from the underlying warmer sea bottom and from the overlying warmer water In this manner its temperature near the bottom is gradually raised from about $-1°3$ C to about $-1°$ C Nansen estimates that at least two-thirds of the whole basin of the Norwegian Sea is filled with cold bottom water The renewal of the cold bottom water in the basin of the Norwegian Sea must be an extremely slow process, and it has been established by actual observation that the bottom water does not extend across the ridge anywhere between Iceland and Norway, where the temperature is nowhere below zero Further, he thinks that it is very improbable that any bottom water with a temperature below $-1°$ C ever gets across the ridge between Iceland and Greenland

For the North Polar basin Nansen considers the minimum temperature to be between $-0°8$ C and $-0°9$ C, the salinity being about 35 1 per cent If existing observations are confirmed, in his judgment the possibility of a communication between the deep North Polar basin and the deep basin of the Norwegian Sea, as well as of their bottom waters, will be finally excluded In that case he thinks that there are two regions where the bottom waters of the North Polar basin might originate by being cooled down directly through radiation from the sea surface, namely, in the seas north of Spitsbergen and near northern Nova Zembla Nansen is further of opinion that the renewal of the cold bottom water of the enclosed North Polar basin will occur even more slowly than the corresponding renewal in the Norwegian Sea, so that a much smaller quantity of water

[1] "Northern Waters Capt. Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the Bottom-waters of the Northern Seas. By Fridtjof Nansen Pp 154 11 plates. (Christiania Jacob Dybwad, 1906)

will be required yearly to feed the circulation of the cold bottom water in the North Polar basin

This brief outline of the contents of this interesting memoir will give some idea of the thoroughness of its scientific methods and the great labour that has been bestowed upon them

THE COMMEMORATION OF LORD LISTER'S EIGHTIETH BIRTHDAY

THE eightieth anniversary of the birthday of Lord Lister occurred on Friday last, April 5 Many scientific men have had the good fortune to discover the causation of phenomena of immediate practical importance but to few have been vouchsafed the privilege of seeing the results of their discoveries become in a few years of such enormous benefit to their fellow men as those of Joseph Lister No man alive has by a single discovery conferred upon the whole of mankind a greater boon than did the surgeon who discovered the causation of the direful but not unusual *sequelae* of a surgical operation, viz suppuration, septicæmia, secondary hæmorrhage, erysipelas, and hospital gangrene, and who showed that by preventing the access of bacteria to wounds all these diseases could be avoided

It is just forty years since the first papers of Lord Lister dealing with his discoveries were published in the *Lancet* How the best skill of the surgeon was baffled by these wound infections and the whole development of surgery prevented may be realised by a quotation from a leading article in the *Lancet* written at the time of the publication of one of Lister's earliest papers in 1867

> The mortality of compound fractures of amputations and operations and of lithotomy in our larger hospitals, both provincial and metropolitan, is something frightful And the occurrence of death with symptoms of blood-poisoning is unfortunately not confined to cases of serious operation but happens ever and anon in operations in themselves slight The risk of blood-poisoning is indeed now the one great opprobrium of surgery There is no limit to the operative feats of surgeons, but there is a miserable and serious risk in every case, especially in hospitals, of the occurrence of fatal after-consequences against which—until now at least—we have had little or no power of resistance

The story of the discovery of antiseptic surgery was briefly told by Lord Lister himself in the third Huxley lecture delivered in 1900 In this lecture Lord Lister explained how by the time he became a house-surgeon at University College he was already endowed with a love of physiology and a first rate microscope The former he owed to the inspiration of Prof Sharpey and the latter to his father who did so much to raise the compound microscope from little better than a toy to the powerful engine for investigation which it then was As a young surgeon his attention was immediately turned to the study of those scourges of surgery, suppuration pyæmia and hospital gangrene During the next ten years he made a number of investigations upon the early stages of inflammation and the healing of wounds He was early led to the conclusion that suppuration and septic diseases were due to a poison acting locally and again and again he searched with the aid of the microscope the discharges from wounds in the hope of discovering some *materies morbi* of an organised kind

The idea that wound infections were of parasitic origin although the parasite escaped detection was early in his mind, so that when the epoch-making discoveries of Pasteur on the nature of fermentation and putrefaction were published Lister was prepared to appreciate the analogy between these phenomena and those of wound infection. Guided by this analogy, he devised methods to prevent the entrance of germs to wounds, and was immediately successful in obviating the evil effects hitherto so generally attendant upon the simplest operation.

The actual methods employed have undergone some modifications and simplification in accordance with the development of knowledge during the last fifty years, but the principle to protect wounds from the access of germs "by means which shall disturb the tissues as little as is consistent with the attainment of the essential object" retains its full value at the present time

Lord Lister has been the recipient of many honours bestowed upon him by every civilised community, but it was widely desired that his eightieth birthday should be suitably commemorated It was considered by some of his admirers that this could best be done by the re-publication, by subscription, of his collected work in suitable form Invitations were accordingly issued to a number of scientific and medical men, both at home and abroad, to form themselves into a committee for this purpose The invitations have met with a warm response, and the committee may be described as an international one

A meeting of this committee took place on Thursday, April 4, at the Royal College of Surgeons, which was presided over by Mr Henry Morris, the president of the college It was unanimously resolved to ask Lord Lister to allow the committee to re-publish his scientific papers, and a small editorial committee was chosen to carry out this object The following letter was sent to Lord Lister from the committee —

DEAR LORD LISTER,

A desire having been widely felt that the eightieth anniversary of your birthday should be marked in some special manner a committee of your professional brethren both at home and abroad was formed to consider in what way this could best be done

This committee met to-day at the Royal College of Surgeons when it was unanimously resolved to ask you to allow them to commemorate the occasion by collecting and publishing your various scientific papers in book form In anticipation of your acquiescence an editorial committee was appointed to carry out such publication

At the same time those present at the meeting wished to convey to you their warmest congratulations on this occasion, and gratefully to acknowledge the debt which the medical profession, and, indeed, the whole world, owe to you for the work which you have done That you have lived to see such enormous advances in surgery and medicine flow from your work must be a source of great gratification to you and the committee hope that you may be spared to see still many further advances follow therefrom

I remain, dear Lord Lister,
Yours sincerely
(Signed) HY MORRIS
President, Royal College of Surgeons, Chairman

Lord Lister replied to the letter as follows —

DEAR MR MORRIS,

I duly received your letter yesterday informing me of the decision of the general committee to ask me to allow them to commemorate the occasion of my eightieth birth day by collecting and publishing my various scientific papers in book form

This proposal is almost overwhelming in its kindness, and I expressed to the deputation which met here in the morning my profound sense of gratitude This surpassingly generous offer is extremely gratifying to me

Believe me,
Very sincerely yours,
(Signed) LISTER

It is proposed to issue the collected papers in two quarto volumes of about 450 pages each The volumes will contain a portrait of Lord Lister, and will be prefaced by a short account of the development of Lister's ideas and work and their relation to the growth of knowledge of infectious processes They will be published at a subscription price of one guinea for the two volumes

NOTES

SIR JAMES DEWAR has been appointed a corresponding member of the Royal Academy of Sciences, Denmark

THE U S Congress has voted 20,000*l* for the erection of a monument to Christopher Columbus at Washington

PROF S. P THOMPSON, F R S, has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services"

MR J DE GRAAF HUNTER, assistant in the physics department of the National Physical Laboratory, has been nominated by the India Office to the post of mathematical expert to the Survey of India

THE monument erected by subscription in the garden of the Paris Institut national agronomique to Eugène Risler, the director of the institute from 1879 to 1900, was unveiled by M Ruau, the French Minister of Agriculture, on March 24

THE *British Medical Journal* states that a laboratory for the study of human nutrition is to be built by the Carnegie Institute of Washington on a site adjacent to the Harvard Medical School The work will be under the direction of Prof F G Benedict, of Wesleyan University

IN many places the rainfall measured already this month is greatly in excess of the aggregate measurement for the whole of March On the night of April 6–7 there was a somewhat heavy fall of snow over the south of England, and at Warlingham in Surrey, the ground was covered to the depth of 6 inches In London, snow fell for some time in the early morning of Sunday, April 7, and the rainfall as yet this month already exceeds an inch Thunderstorms have also occurred in different parts of the country Notwithstanding that the aggregate rainfall at Greenwich for the first three months of the year was deficient by 1 63 inches, the total for the six winter months, October–March, was 0 75 inch in excess of the average for the past sixty years

THE earthquake at Bitlis on March 29, briefly recorded in last week's NATURE, appears to have been of unusual severity, and was registered by seismographs at several distant stations The earthquake occurred at 10 a m on March 29, no fewer than fourteen severe shocks being felt on that day Shocks stronger than the first were felt at Bitlis all night on March 31, resulting in fresh casualties and further destruction of houses Violent shocks of earthquake were felt on April 2 in the island of San Miguel, Azores, particularly in the town of Villa Franca, which was formerly destroyed by earthquake

THE two Royal medals of the Royal Geographical Society have been awarded, with the King's approval, to Dr Francisco Moreno, who for more than twenty years has been personally occupied in the work of South American exploration, and Captain Roald Amundsen, the Norwegian explorer who recently completed the North-west Passage for the first time in a ship, and made observations in the neighbourhood of the North Magnetic Pole The Murchison bequest of the society has been awarded to Captain G E Smith, for his various surveys in British East Africa the Gill memorial to Mr C Raymond Beazley, for his work in three volumes on "The Dawn of Modern Geography", the Back bequest to Mr C E Moss, for his researches on the geographical distribution of vegetation in England, and the Cuthbert Peek fund to Major C W Gwynn, C M G, R E, for the geographical and cartographical work carried out by him in the Blue Nile region and on the proposed Sudan-Abyssinian frontier

To the long list of eminent men of science that have lately been lost to France by death must be added the name of Colonel Laussedat, for many years the director of the Conservatoire des Arts et Métiers More than sixty years ago he began his public career in the École Polytechnique, and his long life was one of successful achievement He served his country both in the field and in the study During the siege of Paris he had charge of the optical contrivances for maintaining communications with the outside world, and later at the close of the war, he was a member of the commission for arranging the new frontiers of the country Besides filling the office of professor of geodesy, he was at different times member of many committees and numerous commissions, where his experience knowledge, and ingenuity were gratefully acknowledged But it is in the department of photography and in its applications to scientific purposes that he will be longest remembered If he did not originate the application of photography to surveying and photogrammetric inquiries he so encouraged its employment, improved its methods, and demonstrated its usefulness that he won for it a foremost place in the training of every modern topographer Colonel Laussedat was a member of the French Academy and of many learned societies in his own and other countries

As previously announced the annual meeting of the Iron and Steel Institute will be held on May 9 and 10 At the opening meeting, the retiring president, Mr R A Hadfield, will induct into the chair the president-elect Sir Hugh Bell, Bart, the Bessemer gold medal for 1907 will be presented to Mr J A Brinell (Stockholm), and the president will deliver his inaugural address Among the papers to be submitted on May 9 and 10 are the following —The use of steam in gas producer practice Prof W A Bone F R S and R V Wheeler, the influence of process of manufacture on some of the properties of steel F W Harbord, the ageing of mild steel, C L Stromeyer carbon-tungsten steels, T Swinden, the nomenclature of iron and steel report of a committee of the International Association for Testing Materials Reports on research work carried out during the past year will be submitted by C A F Benedicks (Sweden) O. Stutzer (Germany), E F Law (London), E Hess (United States) P Breuil (Paris), H C Boynton (United States) L Guillet (France), W H Hatfield (Sheffield) A Campion (Glasgow), F G L Roberts (London), E A Wraight (London), and W Rosenhain (Teddington) Carnegie research scholars The annual dinner of the institute will be held in the Grand Hall of the Hotel Cecil on May 10, under the presidency of Sir Hugh Bell, Bart The council has accepted an invitation to hold the autumn meeting of the institute in Vienna on September 23–25 After the meeting there will be alternative excursions to

Bohemia and Styria, by invitation of the Prague Iron Industry Company and the Austrian Alpine Mining Company respectively. An invitation has also been received from the Witkowitz Mining and Ironworks Company to visit their works.

In an elegant little pamphlet entitled the "Birdland Booklet," Messrs. Sanders and Crowhurst direct the attention of amateur photographers to the advantages of their reflex birdland camera.

Most of the articles in Nos. 5 and 6 of the *Bulletin International de l'Académie des Sciences de Cracovie* for 1906 relate to physiological and chemical subjects, but Mr. W. Kulczynski contributes a continuation of an account of certain arachnid groups, dealing in this instance with the European representatives of the genus Amaurobius. The article, which is in Latin, is illustrated with two plates, and contains descriptions of twenty species, one of these being new.

A specimen of the so-called "sea-mignonette" (*Primnoa reseda*) dredged in the Færoe Channel, has enabled Prof. J. A. Thomson in the Proceedings of the Royal Physical Society of Edinburgh, vol. xvii., No. 2, to state that this gorgonian is one of the most gorgeously coloured members of the British fauna, being naturally a brilliant salmon pink, although the tints rapidly fade after exposure to light. Prof. Thomson has also discovered that this species, the only member of its genus, is viviparous.

The appearance of the first part of a work entitled "The Book of the Open Air," edited by Mr. Edward Thomas, and published by Messrs. Hodder and Stoughton, may apparently be taken as an indication of an increasing appetite on the part of a considerable section of the public for anything connected with country life and popular natural history. The illustrations, of which fifty are promised, are all to be coloured, and the work is to be completed in a dozen shilling parts. The illustrations of scenery in this part are simply exquisite, and, even though the naturalist may consider those of animals a little too "artistic" in colouring, if the present standard is maintained the volume will be a marvel of cheapness. The names of Messrs. W. H. Hudson and J. C. Tregarthen are alone sufficient to indicate that the letterpress will not be deficient in interest.

The list of New Guinea mammals published by Dr. F. A. Jentink in vol. xxviii. (pp. 161 *et seq.*) of Notes from the Leyden Museum presents a remarkable contrast in point of extent to those in most text-books, comprising no less than 127 species and subspecies. The number recognised by Dr. Wallace in his "Malay Archipelago" (1869) is, for instance, only seventeen, while even so late as 1897 Dr. K. M. Heller could enumerate not more than seventy species from the whole of the Papuan Islands. Probably a few of the forms entered in Dr. Jentink's list are not entitled even to subspecific rank, but, discounting this, the length of the list is sufficient to refute the old idea that New Guinea is very poor in mammals. As to the future, the author is of opinion that exploration of the practically unknown mountain interior of New Guinea—a country larger than Borneo, and double the size of Great Britain—will probably yield a number of new forms.

The latest issue (vol. iv., parts xiv. and xv., published together) of *Spolia Zeylanica* contains an illustrated account by Dr. Günther Enderlein of a large number of new minute insects belonging to the same group of Neuroptera as the European book-lice and death-watches. The few Ceylonese forms previously known were chiefly those described by Hagen in the years 1858 and 1859, but Dr. Enderlein has been enabled to reveal the existence of quite a host of these tiny insects, referable to a number of new generic types. In place of grouping all these "scaly-winged Copeognatha" in the single family Psocidæ, as is done by Dr. David Sharp, the author refers them to three distinct families, confined almost exclusively to the tropics, the only exceptions being one species from Japan and two from North America. Of the nineteen recognised genera, fourteen are named by Dr. Enderlein. In general appearance and the beauty of the pattern and colouring of their scale-clad wings (exquisitely shown in the coloured plates illustrating the memoir), these insects recall the Microlepidoptera. The use of the term "woodlice" as their popular designation is, as the editor of *Spolia Zeylanica* points out, barred by the employment of that name in another sense.

A very important paper, by Profs. J. T. Wilson and J. P. Hill, on the fœtal dentition of the Australian duck-bill, or platypus (Ornithorhynchus), is published in the February issue, vol. li., part i., of the *Quarterly Journal of Microscopical Science*. The authors announce the discovery of tooth germs belonging to at least two distinct dentitions. What may be called the second dentitions seems to comprise five pairs of teeth in each jaw. Of these, the last three clearly have deciduous predecessors, and they may therefore be regarded as molars, while if such predecessors are absent in the two anterior teeth (a point not yet definitely ascertained), these will be premolars. It is noteworthy that of the three functional teeth in the upper jaw, the first, and smallest, pair belongs to this presumed premolar series, which is unrepresented in the functional lower teeth. Very noteworthy is the discovery that the vestigial precursors of the large functional molars take the form of a much more numerous series of dental rudiments, each corresponding approximately with one of the cusps of their complex successors. "The mode of development of the successional molars ... is decisive against the occurrence of any fusion-process, but the relation of the two series in the molar region cannot but be regarded as suggestive of some sort of phylogenetic substitution of a small number of compound teeth for a large number of simple teeth—a process which must be reckoned as covering the fundamental idea of concrescence."

The Board of Agriculture and Fisheries has published a new edition of the leaflet on the black currant mite, in which information on the treatment of this pest with lime and sulphur has been incorporated. Fruit growers whose bushes have been attacked with the mite are advised to experiment with this process. Copies of the leaflet may be obtained gratis and post free on application to the Secretary of the Board of Agriculture and Fisheries, 4 Whitehall Place, London, S.W. Letters so addressed need not be stamped.

The general conclusions derived from former attempts to grow the opium poppy with a view to the production of alkaloids have been adverse to the profitable cultivation of the plant in Europe. A recent experiment made by Dr. H. Thoms at Dahlem, near Berlin, of which an account is published in *Berichte der deutschen pharmaceutischen Gesellschaft*, vol. xvii., promises no better. The fruits of German varieties gave considerably higher yields than the

fruits of plants raised from imported Asiatic seed, but the cost of labour proved prohibitive, further, the yield was found to be uncertain.

WHETHER it is regarded as an exposition of the new rules for botanical nomenclature or as an authentic revision, the thanks of the botanical community are due to the trustees of the British Museum for publishing, and to Dr. A. B. Rendle and Mr. J. Britten for compiling, a list of British seed plants and ferns to conform with the decisions adopted at Vienna in 1905. The sequence of orders follows Bentham's "Handbook", the limitation of species is based on Messrs. Groves's revised edition of Babington's "Manual," while additional insertions correlate the names given in Bentham's "Handbook," Hooker's "Student's Flora," and the previous edition of Babington's "Manual." The form is similar to that of the London Catalogue, which it presumably will supplant.

WHILE studying the subject of polymorphism in the Hymenomycetes, a basidiomycetous subclass of fungi, Mr. G. R. Lyman has added to our knowledge of subsidiary spore-forms. It was found that oidia are commonly developed upon the mycelia in the Polyporaceæ and Agaricaceæ, but rarely or never in the lower orders. Chlamydospores previously recorded for a few agarics and many of the Polyporaceæ were produced under cultivation on the mycelia of species of Corticium and some of the Hydnaceæ. Conidia were most frequently observed in the Thelephoraceæ. Peculiar reproductive structures not unlike immature ascocarps, receiving the name of bulbils, were discovered in *Corticium alutaceum*, this being the first record for a basidiomycetous order. The paper is published in vol. xxxiii., No. 4, of the Proceedings of the Boston Society of Natural History.

THE issue of *Irish Gardening* for the current month contains an article by Dr. G. H. Pethybridge on the American gooseberry-mildew in Ireland. This mildew (*Sphaerotheca mors uvae*) was the subject of an article in these columns on December 13 last (vol. lxxv., p. 160), and of a letter from Mr. E. S. Salmon in our issue for January 10 (vol. lxxv., p. 247). Dr. Pethybridge says that everyone who has come into working contact with the disease in Ireland admits its destructive nature. Last year nineteen counties out of Ireland's thirty-two had records of the disease, and the ninety-eight localities in which it has been reported since the first case in 1900 are indicated on a map accompanying the paper. There are now about 100 cases of the mildew in Ireland, and to state that the disease exists "in hundreds of gardens" in Ireland is an unnecessary exaggeration. The greatest stronghold of the disease is at present in the north-east of Ireland, more or less in the neighbourhood of the first outbreak, and many of these cases have undoubtedly arisen by the transference of the spores by natural agencies from one garden or plot to neighbouring ones. Corresponding to the increased number of cases during last summer, there has been an increased effort to eradicate the disease, especially by spur pruning and burning, and it is to be hoped that systematic spraying with potassium sulphide solution will be carried out in every garden or plot in which the disease existed last summer. In order to settle the question as to whether spraying is of use or not in combating the disease in Ireland, what is wanted is a carefully carried out set of experiments with the necessary controls, and Dr. Pethybridge understands that the Irish Department of Agriculture has such experiments in hand for the coming season.

THE Home Office reports on the Wingate Grange colliery explosion on October 14, 1906, have been issued as a Blue-book (Cd. 3379). It is shown that the explosion, which caused forty-four deaths, was due to coal dust and not fire-damp, and that the cause of the explosion was a charge of geloxite, a permitted explosive, fired by means of a fuse. It is evident that, as coal mines are becoming deeper and drier, and larger areas are being worked from a pair of shafts, care should be taken to mitigate the dangers arising from the presence of coal dust. For this purpose steps should be immediately taken to make obligatory the removal of all coal dust from the in-take air ways and mechanical haulage roads of collieries. Attention is directed to the Blue-book by Mr. John Wilson, M.P., in his circular to the Durham Miners' Association, and also by Mr. Thomas Burt, M.P., in his monthly circular to the Northumberland Miners' Association.

THE increasing application of electric power to mining operations was clearly shown in two papers by Mr. M. Kellow and Mr. A. H. Preece read before the Institution of Civil Engineers on March 26. Mr. Kellow described a hydroelectric plant containing many features of novelty installed at a Welsh slate mine. The scheme has been carried out in the Croesor and Cwmfoel valleys, in the vicinity of Snowdon, and includes all the essentials of a complete power system, it being the first example of so high a head of water as 860 feet being utilised in the United Kingdom. The advantages of the three-phase system as applied to slate mining were summarised, and the plant installed for mill driving, winding, haulage, pumping, and lighting at the Croesor slate mine was described. In the second paper Mr. Preece dealt with electrically driven winding gear, and referred to various points relating to the cost of electric power in mines.

THE Geological Survey of Canada has issued the annual report of the section of mines (No. 928), giving the completed and revised information descriptive of the mineral industries of Canada for 1904. The report has been drawn up by Mr. E. D. Ingall. The Geological Survey has also issued reports on the Chibougamau mining region in the northern part of the province of Quebec, by Mr. A. P. Low (No. 923), and on the Rossland mining district, British Columbia, by Mr. R. W. Brock (No. 939). The former, which covers sixty-one pages and is accompanied by a coloured geological map on a scale of four miles to the inch, records the discovery of an area of serpentine rocks containing asbestos of excellent quality, and the finding of a large vein of gold-bearing quartz and numerous indications of copper ore. The latter report, which is of a preliminary nature, clearly shows the development and progress of gold, copper, and silver mining in the Rossland district. We have also received a somewhat belated report (No. 908, Ottawa, 1905) on recent mineral discoveries on Windy Arm, Tagish Lake, Yukon, by Mr. R. G. McConnell. The deposits consist of quartz veins, the principal values in which are in silver.

A VALUABLE paper on the testing of electric machinery and of materials for its construction, read by Prof. Epstein before the Institution of Electrical Engineers, is published in full in the last issue (vol. xxxviii., February) of the Journal of the Institution. The paper was the direct outcome of the information supplied to one of the Engineering Standards Committees during the last eighteen months by the author, and is exceptionally interesting from both the purely scientific and practical engineering points of view. Prof. Epstein describes fully the various methods of testing the materials used in the manufacture of

electrical machinery and the uses to which the results obtained in the laboratory are put in practical design That these results must not always be blindly followed is shown by the fact that in some cases where the efficiency obtained in a laboratory test is very high, when the material tested is taken for practical use it is of no value for manufacturing purposes owing perhaps to porosity or other defect Consequently the paper is of special value in that the results of many years' work are given, thus providing what is probably the most accurate data for the design of modern electrical machinery Every material used in the construction of the dynamos, motors transformers &c of the present day has been scientifically tested, and the results are now classified The various classes of iron, copper, carbon, and insulating material have been thoroughly sifted so that efficient and commercial combinations have been secured

FROM Messrs Adam Hilger Ltd we have received a brief description of the 1907 model of their well known wave length spectroscope The growing demand for these spectroscopes by education authorities, research workers, and technical experts has enabled the makers to add numerous improvements, and, from the description the present model appears to be mechanically and optically ideal The telescope and collimator have a focal length of 11½ inches and an aperture of 1¼ inches The prism-train effectively consists of two 30° prisms and one 90° reflecting prism, but is actually made in one piece The bearing part of the screw on which is fixed the helical drum on which the wave lengths are engraved is especially worked and hardened and presses against a hardened steel plug the surface of which is optically polished thus imperfect contacts and periodic errors are eliminated These improvements have necessitated slightly increased prices the present cost of the spectroscope with a prism of 1.65 refractive index for D, being 25*l*. and for a refractive index of 1.74 27*l*. 15*s*.

THE Perkin memorial committee has issued as an attractive volume appropriately bound in mauve an account of the proceedings in connection with the International Celebration of the Coal-tar Colour Jubilee with which we dealt in an article in our issue for August 2, 1906 (vol lxxiv, p 318), and in numerous notes published from time to time The jubilee volume contains the special report by the *Times*, the whole of the telegrams, letters, and addresses received by Sir W H Perkin, F R S, several of the speeches made at the Royal Institution and at the dinner at the Hôtel Métropole and a report of the celebrations held in America It is illustrated by reproductions of the portraits of Sir W H Perkin and of his father and brother views of the Greenford Green Works and photographs of the oil portrait and marble bust presented to Sir W H Perkin by international subscription The volume forms a fitting memento of an important and interesting event

THE coefficient of expansion of fused quartz is the subject of a paper by Mr Howard Minchin in No 1 of vol xxiv of the *Physical Review* the determinations were made by the interference method over ranges of temperature between +16° C and +1000° C, and the conclusion is drawn that between these limits expansion is uniform the mean coefficient α having the value 0.440×10^{-6} In No 1 of vol ix of the *Verhandlungen* of the German Physical Society, Dr Karl Scheel publishes a communication from the Physikalisch-Technischen Reichsanstalt dealing with the expansion of crystalline quartz in the direction of the axis, and of platinum, palladium, and quartz glass between the temperatures of −190° C and +100° C These determinations were also made by the optical method The coefficient of expansion of quartz glass is given by the equation

$$l_t = l_0(1 + 0.217\ 10^{-6}\ t + 0.002379\ 10^{-6}\ t^2),$$

and it is seen that, between the interval −190° C and +16° C instead of an expansion occurring, a contraction of 41 μ per metre is observed The curve of expansion of quartz glass thus shows a minimum at a temperature of about −46° C

A CORRESPONDENT suggests that the passing allusion made to the collection of ship models in the Victoria and Albert Museum, in the review of Sir George Holmes's book in NATURE of March 28 (p 506), may lead readers to suppose that no models of warships are contained in the collection As a matter of fact, there is a section devoted to warships, and including a number of models lent or given by private firms

THE first part of the third edition of Prof M Lévy's well-known work on "La Statique graphique et ses Applications aux Constructions" has been published by MM Gauthier-Villars, Paris Although some changes have been made, in details the work remains substantially the same The part just received deals with the principles and applications of pure graphic statics, and is published in two volumes—one containing the text (pp xxx+598) and the other (Plates xxv) the figures

IN the second revised edition of "Die Spiele der Tiere," just published by Mr Gustav Fischer, Jena, Prof K Groos has made numerous changes The book is full of interesting incidents and explanations relating to the play of animals, and appeals both to the naturalist and psychologist A translation of the original edition into English appeared in 1898, and was described in these columns (vol lviii, p 410)

EIGHT new volumes (Nos 151–8) of Ostwald's scientific classics have been received from Mr W Engelmann, Leipzig The volumes contain papers, in German, by Poinsot (1809), Cauchy (1811), J Bertrand (1858), Cayley (1859), Grotthuss, on electricity and light (1808–1819), Hankel (1870), Dutrochet (1824), Zamboni, Sella, Jacobi, and Toepler (1866–7) Each volume includes editorial notes, as well as reprints or translations of original papers, so that students of science familiar with the German language are provided by Prof Ostwald's series with a ready means of referring to the works of the old masters and receiving inspiration from them

THE Country Press, of Kensington, London, W, has issued two more packets of nature-study post-cards One packet includes facsimiles of six British trees in winter, the other provides natural figures of boles of the same trees The packets are issued at 6*d* each

MESSRS J AND A CHURCHILL have published a fifth edition of "Elementary Practical Chemistry," by Dr Frank Clowes and Mr J B Coleman The book is published in two parts, the first dealing with general chemistry and the second with qualitative and quantitative analytical chemistry In the present edition the whole of the matter has been revised, and alterations and additions have been made

WE are indebted to the publisher, F Tempsky, of Vienna, for a copy of the fifth edition of Graber's "Leitfaden der Zoologie," edited by Dr Robert Latzel This well-known illustrated text-book is intended primarily for use by the higher classes of the middle schools

OUR ASTRONOMICAL COLUMN

COMET 1907*a*.—No. 4165 (March 26) of the *Astronomische Nachrichten* contains a new set of elements and an ephemeris for comet 1907*a* (Giacobini), calculated by Herr M. Ebell from places observed on March 9, 12, and 16. According to the elements, the perihelion passage took place on March 26, and, as shown by the ephemeris, the comet's brightness is decreasing, now being less than half what it was at the time of discovery. The position of this object for April 11 is $\alpha = 6h.\ 14m.$, $\delta = +4^\circ\ 47'$, and the comet is travelling in a nearly due northerly direction, its calculated position for May 6 being 6h. 10m. $+13^\circ\ 42'$.

THE BRIGHTNESS OF THE SKY NEAR THE SUN'S LIMB.—With an apparatus described in No. 4164 (March 25) of the *Astronomische Nachrichten*, Prof. Ceraski, at Moscow, determined the relative intensities of the light at the sun's limb and the atmospheric illumination very near the limb on November 3 and 4, 1906. On the former date the mean value of the ratio $\frac{\text{edge of} \odot}{\text{atmosphere}}$ at the east and west limbs was 31.4, and on November 4 it was 38.4, values far below those which Prof. Ceraski expected to find.

Prof. Ceraski points out that this ratio might be employed as a term of comparison in evaluating the relative intensity of the corona. Using the method described by him in No. 4106 of the *Astronomische Nachrichten*, the coronal light could be compared with that of a standard lamp, which might, after the eclipse, be measured against the illumination of the atmosphere at a determined point in the sky. Thus the illumination of the sun's edge could be compared indirectly, in graduated steps, with that of the corona.

RADIAL VELOCITY OF η PISCIUM.—This star was announced by Mr. Lord as a possible spectroscopic binary having a long period, but Prof. Campbell was unable to find any variation in the line-of-sight velocity. The binary character is now confirmed by plates secured at the Dominion Observatory at Ottawa, the range of velocity so far detected being from +5.4 km. to +21.4 km. per second, and there are indications that the period is a comparatively short one.

α Draconis has also been observed, and the velocity curve practically completed; the period is between fifty and fifty-one days, and the velocity ranges from −53 km. to +35 km. per second.

In the case of ι Orionis, a considerably larger range of velocity than that announced by the discoverers was found, that already observed extending from −50 km. to +100 km. (the Journal R.A.S. Canada, No. 1, vol. i.).

SIMULTANEOUS OBSERVATIONS OF JUPITER.—In the *Bulletin de la Société astronomique de France* for December, 1905, it was suggested that simultaneous observations of Jupiter should be made by as many volunteer observers as could be obtained, and that the results, obtained with many different kinds of instruments and under varied conditions, should be communicated to and coordinated by the society.

One hundred and seventy-two observers made observations at prearranged hours on various dates between January 2 and 20, 1906, and the first batch of results is now discussed by M. Mascart in the April number of the *Bulletin*, the general conclusions derived from all the observations on one day being given, together with reproductions of the original drawings for January 2, 3, 4, and 5, 1906.

THE SUN AS A VARIABLE STAR.—At the meeting of the Royal Astronomical Society held on March 8 Prof. Turner briefly discussed the light curves of a number of variable stars, and showed that there existed a sequence in their forms. In most cases the minimum falls later than mid-way between two maxima, in others earlier, and on arranging the curves of thirty-one variables it was found that the sun falls into the sequence. Seeking some explanation for this arrangement, Prof. Turner has evolved the interesting suggestion that the form of the curve may to some extent, depend upon the position of the star's axis in regard to the line of sight; thus we view the sun from a point lying nearly in the plane of its equator, but the poles of other stars may be turned towards us, whilst in other cases we may be looking normally at mid-latitudes.

An analysis, from this point of view, of the suitable data given in Chandler's catalogue of variable stars led to the tentative result that whilst the stars where we look directly at the equator are distributed in all galactic latitudes, those of which we see the polar regions are absent from the neighbourhood of the galactic poles. As a purely speculative interpretation of this difference, Prof. Turner suggests that the axes of the stars may be nearly parallel to the plane of the Milky Way, an arrangement which would, of course, account for the result found (the *Observatory*, No. 382, April).

EFFECTS OF PRUNING ON FRUIT TREES.

THE scientific work carried on at the Woburn Experimental Fruit Farm, by the Duke of Bedford and Mr. Spencer U. Pickering, F.R.S., is of great value to horticulturists who usually follow rule-of-thumb methods in much the same way as the British farmer cultivates his crops. The fifth report of the Woburn Fruit Farm, noticed in NATURE of September 7, 1905 (vol. lxxii., p. 461), showed that several cherished ideas as to the proper treatment of fruit trees need modification, and that operations which are generally supposed to be beneficial to growth and fruit-bearing are really prejudicial to both. Measurements of leaves, trees and fruits, and weighings of the fruit, led to the conclusions that heavy thinning of the fruit is of no advantage, hard pruning is unprofitable, summer pruning is undesirable, and root pruning injurious. An explanation was also found of the fact that carelessly planted trees, though weak at first, ultimately make more growth than trees carefully planted.

The observations described in the fifth report of the Woburn Fruit Farm have since been extended, and the new results and conclusions are dealt with in the seventh report recently issued.[1] As the conclusions are based on experimental evidence, they are, of course, of far greater value than mere expressions of opinion, and though they apply only to particular trees in a particular soil, they suggest that the ways of the practical gardener are not always wise. The empirical horticulturist believes that "growth follows the knife," but by measuring and weighing trees it has been found that the less a fruit tree is pruned the larger and heavier it becomes, even when allowance is made for the amount of wood removed in the annual pruning of the normal trees. The fruit crops of trees are also increased as the amount of pruning is diminished, so it appears that the less pruning done the better is the result both as regards growth and fruit.

These conclusions, however, apply only to healthy and established trees. Transplanted, injured, or ailing trees may be regarded as prematurely old trees which tend to form an excessive number of fruit buds and increased wood formation. The obvious way to prevent this is to prune hard, and the experiments at Woburn show clearly that if transplanted trees, that is, trees which have been checked in their development, are cut back at once the operation results in the starting of many dormant buds followed by a clean, vigorous growth. Hard pruning also results in increased branch-formation in the case of mature trees, the effect being thus the opposite to what is found when the pruning is on young trees in the full vigour of growth.

The experiments show, in fact, that with trees, as with animals, there are certain periods in their life-history characterised by certain distinct differences of behaviour. All the results obtained at Woburn can be explained by remembering that any cause which disturbs the balance between the root and branch systems at any period of growth is followed by an effect which will adapt the organism to the new condition. The observations are thus not only of importance to practical horticulturists, but are also of scientific interest. The summary of the report, re-

[1] Seventh Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford, K.G., and Spencer U. Pickering, F.R.S. Pp. 56. (London: Eyre and Spottiswoode, 1907.) Price 1s. 6d.

printed below by permission of the authors, presents the results in a convenient form, but a study of the report itself is necessary to appreciate the value of the experiments upon which the conclusions are based.

Records have been kept during the last twelve years of the behaviour of apple trees when pruned to different extents. The trees were chiefly dwarf trees on the paradise stock, and the main series of experiments were made on three varieties, possessing very different habits of growth. Measurements of the height of the trees, the spread of the branches, and the diameter of the stems led to the conclusion that the less the tree was pruned the larger did it become, and this conclusion has now been confirmed by lifting more than half the trees and ascertaining their weight. At the end of twelve years (the trees then being fifteen years old), those which had not been pruned at all were 20 per cent. heavier than those which had been moderately pruned, whilst those which had been hard-pruned were 16 per cent. lighter. The difference in weight between the unpruned and moderately pruned trees was too great to be accounted for by the weight of wood removed in the pruning, so that pruning not only does not increase the actual size of a tree, but it results in less new wood being formed.

These results were further established by pruning to different extents similar branches on the same tree. The less the pruning done the greater was the number, length, and weight of the new shoots formed, and the greater also, was the increase in girth of the original branch.

From every point of view, therefore, the pruning of a healthy, growing tree seems to be inimical to wood formation.

It is as regards the crops, however, that a reduction of pruning shows to greatest advantage. With the dwarf apple trees, the crops during the first five years were more than twice as great from the unpruned trees as from the moderately pruned ones, and more than three times as great as from the hard-pruned ones; in the second period of five years the differences were still greater, and in the twelfth year (when, however, one variety only was in bearing) the unpruned trees yielded nearly three times as much as the moderately pruned ones, and the hard-pruned trees had practically no crop at all. Similar results were obtained during the past season with trees of fifty three and eighty varieties on the crab and paradise stocks respectively, the crops from moderately and hard pruned trees being in the proportion of three to one in both cases. There was no appreciable difference in the size of the fruit from trees pruned to different extents, so that the values of the crops were proportional to the weights. The trees, however, were not allowed to overbear, the fruits being thinned to two to the truss.

Confirmatory evidence of the antagonism of pruning to fruiting was obtained by counting the fruit-buds formed on similar branches of the same tree, which had been cut back to different extents.

All these results refer to healthy trees which are still young enough to be growing vigorously. With a tree which is older, and has attained maturity, the results are somewhat different, not as regards fruiting, but as regards branch formation. With a tree of this age branch-formation under natural conditions, has ceased, but if it be pruned new branches are formed to supply those removed, but they are formed only at the expense of the fruit. Most of the dwarf apple trees (now fifteen years old) used in these experiments seem to have reached this stage; hard pruning in their case now results in an increase of the new wood formed, though the reverse was the case when they were younger, but the crops are still reduced by the pruning, and even more so than in former years.

What applies to a tree which has passed the age of active growth, and has reached maturity, applies also to a tree which has become stunted, or has had its growth arrested by root-injury, as, for instance, when it has been transplanted. The deficiency of vigour of a freshly planted tree is shown by the small size of the leaves and the tendency to form fruit-buds instead of wood. The correction for fruiting is, as has been shown, hard pruning, and it is, therefore, most important that freshly planted trees should be cut back hard so as to prevent precocious fruiting, which would generally result in permanent stunting. To delay this cutting back until the end of the first season would appear to be a very wrong procedure. It has been found that with trees which were not cut back, the size of the leaf was, on the average, 24 per cent. less, and the new wood formed 45 per cent. less, than with similar trees which were cut back; such vigour as the tree possessed went to form fruit-buds, which, when the cutting back was eventually performed, were removed altogether, or suppressed in favour of growth. A year's growth is practically lost by thus deferring the cutting back, and the ultimate result was found to be that the trees thus treated continued to form wood in subsequent years, whilst those which had been cut back at once were fruiting, so that the crop borne by them during the first ten years was only one-third of that borne by the latter.

Experiments on apples, pears, and plums show that the date of cutting back a freshly planted tree is immaterial so long as it is done before growth begins, that is, before about the middle of April. If delayed until the middle of July, the season's growth is much reduced, and the tree will probably suffer in subsequent years. This point was investigated more fully in the corresponding case of the hard cutting back or lopping, of older trees (plums), which had become slightly stunted. The operation increased the amount of new wood formed by the tree, and the results were the same so long as the lopping was done during the dormant season. Lopping towards the end of May resulted in less growth during the year, but this was more than compensated by an additional growth during the succeeding season. It is doubtful, however, whether anything is really gained by anticipating the autumn lopping (as is sometimes possible), and doing it in the preceding early summer, for it was found that the trees thus treated did not appear to be so healthy in foliage as those which were cut back subsequently. This was especially so where the cutting back was postponed until July, for trees cut back then made very little growth during the remainder of that season, and were deficient in growth in the following season as well.

Apart from the cutting back of freshly planted trees, the present results are emphatic in showing that the less pruning is done the better. But this does not imply that no pruning at all should be done. The removal of branches which cross or rub each other, as well as that of any unripened wood, is evidently desirable, and no doubt a certain amount of pruning, in order to obtain a compact and shapely tree, should be done during the first few years after planting. But a tree which is growing freely, and is properly tended in other respects, will require very little pruning to keep it in shape. With precocious or weak-growing varieties more pruning will be necessary, and more is required with standards than with dwarfs, for in the former case it is very desirable that a compact head and strong stem should be obtained before any heavy crops are borne.

STANDARDS AND EXACT MEASUREMENT

THE inaugural address delivered by Dr. R. T. Glazebrook, president of the Institution of Electrical Engineers—the full text of which is published in the current number of the Journal of the society (vol. xxxviii., No. 181, p. 4)—is likely to be remembered as one which stands apart among the various addresses which have been delivered in past years, owing to the fact that the subject treated is so rarely discussed or dealt with in ordinary engineering papers.

The subject in question, that of standards and exact measurement, is one which does not appeal to all, but is of special interest at the present time, when so much has been done of late by the Engineering Standards Committee to bring about more efficient work and more uniform results in the various branches of engineering. Dr. Glazebrook, in opening his address, gave a brief account of the history of standardisation from the first report of the Electrical Standards Committee of the British Association in 1862 down to the present day. This first

early report summed up the entire connection between the various units as follows —

"A battery or rheomotor of unit electromotive force will generate a current of unit strength in a circuit of unit resistance and in the unit of time will convey a unit quantity of electricity through the circuit and do a unit of work or its equivalent"

Mr. Duddell's report on the proceedings at the St Louis Conference brought up the question of electrical standards in its present-day phase Mr Duddell referred to two important resolutions passed at St Louis, and the question of giving effect to these was considered Since then matters have progressed considerably, and a conference was held at Charlottenburg at which representatives from America, Austria, Belgium, France, Germany, and Great Britain were present, and the following resolution was adopted —

"In view of the fact that the laws of different countries in relation to electrical units are not in complete agreement, the conference holds it desirable that an official conference should be held in the course of a year with the object of bringing about this agreement"

The result of the above resolution is that a future conference will be held this year in London, when the question of the fundamental electric units will be brought up Only two electrical units will be chosen as fundamental ones, and these will in all probability be the international ohm, defined by the resistance of a column of mercury, and the international ampere, defined by the deposition of silver

The international volt will depend on the above two definitions Experiments have been going on in all countries since October last to determine with extreme accuracy the quantity of silver deposited in a given time and the best method of constructing practical standards having a resistance of one ohm, and these results will be considered at the conference to be held in London this autumn, when we may hope that definitions of the international ohm and ampere will be finally settled

Not only is it necessary that the fundamental units of electrical science should be the same throughout the world, but the conviction has grown stronger that the extension of this principle would be of enormous assistance to the welfare of nations in general, and consequently international standardisation has become of the greatest importance

At the St Louis Congress two years ago Colonel Crompton introduced this question, with the result that it was unanimously agreed that the cooperation of the technical societies should be secured in order that the questions of the standardisation of the nomenclature and ratings of electrical apparatus and machinery might be thoroughly discussed The Institution of Electrical Engineers appointed an executive committee for this purpose, and practically all the civilised nations of the world cooperated

In this way the International Electrotechnical Commission was formed, and the central offices are for the present in London, at the offices of the Institution of Electrical Engineers

The task before the commission is a large one as the nomenclature alone will probably occupy its attention for a considerable period if one may judge by the labour entailed in the work of the electrical committees of the Engineering Standards Committee, which have been sitting lately

Standardisation has its dangers as well as its advantages, and it is in the avoidance of the one and the utilisation of the other that the great difficulty attendant on the work of such a commission will consist It is to be hoped that a happy mean may be found, which, while reducing the number of types of machinery which the responsible consumer or the consulting engineer can order, will not stultify the inventive faculties of engineers towards future developments

Dr Glazebrook further gives details of the reports of the Engineering Standards Committee on the various sections of engineering work on which it has already reported, the reading of which is of the greatest interest The work appears to have been done in a way that is thorough and complete, and every endeavour has been made throughout to increase the facilities for obtaining greater output per machine and to reduce the multiplication of patterns

It is gratifying to know that the work is already bearing fruit, and the recommendations have been adopted by the Government Departments, Lloyd's Registry, the British Corporation, and several other registry societies in regard to ship and boiler specifications With regard to rails, the Railway Engineers' Association are adopting the standards, and with but few exceptions every new tramway system in this country and many in the colonies which are under construction are being provided with these standard rails It is estimated that the saving to the British manufacturer by standardisation of iron and steel sections alone will amount to some millions sterling and we do not think that this figure is exaggerated when we take into consideration the fact that the frequent changing of the rolls to produce in small quantities the many "special" sizes asked for would be done away with

Although dealing with an infinitesimal part of this vast subject, the address opens out a most important question which will have to be considered, not only by the various branches of the engineering profession, but by every Government that has the welfare of its nation in view Dr Glazebrook is to be heartily thanked for the clearness with which he has dealt with his subject, and there is no doubt that his presidential address to the Institution of Electrical Engineers will long be remembered by those who were fortunate enough to hear it J L M

THE INFLUENCE OF PARASITES ON THEIR HOSTS

SCIENCE of February 8 contains the report of an interesting and suggestive address on this subject delivered by Prof H B Ward before the Section of Biology of the American Association for the Advancement of Science at the New York meeting held in December last (For other presidential addresses see NATURE of February 7, p 352)

After certain preliminary remarks, Prof Ward mentioned that some parasites, such as the distome Heterophyes, found in the intestine of Egyptian fellahin, seem to have no appreciable effect on their hosts The African eye-worm (*Filaria loa*) except when it actually enters the sclerotic of the eye, affords another instance Many encysted worms likewise come under the same category

As a rule, single parasites leave no lasting effects on their hosts, it is rather the multiplication of parasites which should be dreaded The most serious effects occur when this multiplication takes place within the host On the other hand, when multiplication takes place during successive generations in other hosts it is unlikely that the parasites, when in the proper stage, will reach the original host in sufficient numbers to cause serious mischief The real danger lies in a multiple infection through the numerical increase which such a species often undergoes in the intermediate host, or within a limited external area, so that by the intake of a single object a swarm may be introduced

As a rule, the harm caused by a parasite bears some proportion to its size as compared with that of its host, when, however, parasites occupy positions in connective tissue or between muscular fibres they may be relatively harmless, no matter what their size

Some parasites cause harm in a mechanical manner by blocking, for instance, natural passages, or, as in the case of the Egyptian blood-fluke, by the ova entering the capillaries when serious trouble is bound to ensue Embryos, in the case of filariæ, may likewise infest the lymphatic vessels, to the great detriment of their host

The migrations of parasites, as when *Ascaris lumbricoides* passes along the natural gangways from the intestine to the liver, may also cause serious harm, as abscess of the latter organ But parasites do not always confine themselves to such natural lines of movement, they may drive

tunnels for themselves, when still more disastrous results may accrue The abrasion and destruction of surfaces and cells and the opening up of abnormal communications are not, it is urged, of such serious importance of themselves, it is rather the secondary results from such lesions that are to be feared, such, for example, as the admission of bacteria from the alimentary canal into the blood and tissues For it is held by many that the normal mucous surface is impenetrable by bacteria, and the germs of cholera and typhoid depend to some extent upon diminished resistance, functional or structural, for their entrance into the tissues

No one, for instance, doubts that Eberth's bacillus is the active agent of typhoid, but there is strong reason to believe that before it can give rise to the disease there must be lesion of the intestinal mucous membrane The very fact that out of numbers who drink contaminated water but comparatively few are infected is strong confirmation of this

Parasites are likewise the inducing cause of changes which lead to multiplication, or proliferation, of cells and tissue, this being the case with both protozoa and bacteria The most common morphological change in the host is, perhaps, the development of a cyst round the parasite An example of this is afforded in the case of pearls In the Ceylon pearl-oyster the production of the best pearls is due to one particular cestode larva which passes part of its existence in the mollusc itself

On the other hand, the attempt to attribute cancerous and other abnormal growths to the action of parasites does not appear to be supported by the available facts

As regards such proliferation of tissues as is undoubtedly due to parasitic action, Prof Ward advances the hypothesis that this may be largely owing to poison generated by the intruder An inert body like a grain of sand will not give rise to the formation of a cyst or at all events to the proliferation of tissue, and it is probable that pearls cannot be produced by such means Parasitic bodies, on the other hand, feed and excrete, and nothing is more probable than that the excreta are toxic

This however, is not all, for the supply of nutriment to the parasites—nutriment frequently consumed in a wasteful manner—inflicts a severe strain on the host in a large number of instances The drain on the resources of the latter is indeed, practically three fold, owing to the rapid growth of the parasite itself the production by the latter of a large amount of reserve material (glycogen), and the great reproductive activity of the unbidden guest

A curious phase of parasitic infection is the frequent loss of reproductive power in the host due in some instances to destruction of the genital organs themselves, but in others to secondary influences The tendency for one sex to acquire the sexual characteristics of the other is a marked feature in this parasitic castration

The destruction of tissue by parasites, as in the case of that of the liver by the liver-fluke although in one sense a mechanical injury, is really more than this As the substance removed by the liver fluke is replaced by connective tissue, a most important organ of the body becomes to a greater or less degree degenerate

Among the physiological effects of parasitic infection none is more remarkable than the power possessed by species living upon blood of secreting a substance which prevents the coagulation of that fluid In regard to what has been stated above as to the development of toxic elements by parasites, the hæmosporidia of malaria undergo development in the red blood-corpuscles, and when they break up into spores the corpuscles are destroyed, with the probable discharge of poison into the blood As many corpuscles break up at once, the effects are serious The trypanosomes of sleeping sickness probably have a very similar physiological effect The existence of a toxic principle affords also the most satisfactory explanation of the phenomena of the progressive, pernicious anæmia present in some cases of bothriocephalid infection Anæmic conditions are also produced by direct blood-suckers, such as leeches and fish-lice. There remain, however, other forms of anæmia, such as that due to infection by the fish-tapeworm *Dibothriocephalus latus*, the physiology of which cannot at present be satisfactorily explained

THE BELGIAN INTERNATIONAL BALLOON SERVICE.

THE investigation of the higher regions of the atmosphere by means of unmanned balloons, which has been carried on by some countries for several years, generally on the first Thursday in each month, has already revealed some important facts, among which may be mentioned the inversion of temperature at various heights and the determination of the direction of the flow of the upper air-currents over land and sea The success hitherto attained well repays the expenditure of time and money incurred, and gives good reason for hoping that the study of aggregate results may lead to the ultimate solution of the problem of the general circulation of the atmosphere

At the instigation of the aëronautical conference held in St Petersburg in August, 1904, the Belgian Meteorological Service has taken part in this important work since the end of March, 1906, and M Lancaster has sent us preliminary notes of the results of the monthly ascents from Uccle between April, 1906, and February, 1907, published in *Ciel et Terre*, and in a note to the Belgian Academy in November, 1906 We have previously referred to the ascents in April and May, but include the data in the following general summary

The balloons are of india-rubber, coupled in tandem, having generally diameters of 1900 mm and 1350 mm respectively, and are inflated with hydrogen gas The meteorograph is made by Bosch, of Strassburg, and consists of barometer (Bourdon tube), two metallic thermometers (Hergesell and Teisserenc de Bort's models), and hair hygrometer A full description of the apparatus is given in *Ciel et Terre* for May, 1906 In this paper the values quoted are from Dr Hergesell's thermometer The starting place of the balloons at Uccle is 100 metres above sea-level, and the ascents were made from about 7h to 7h 30m a m Greenwich time

General Results of the Ascents

Date	Wind	Temperature at starting	Lowest temperature recorded	Height	Direction in which balloons fell
1906		C	C	metres	
April 5	S	1 9	−57 2	13,500	S S E
May 3	S S W	12 1	−62 6	10,160	E N E
June 7	N E	13 7	−65 7	11,460	S S W
July 5	N E	16 6	−58 0	9,829	S
Aug 2	S S E	22 0	−59 8	13,764	E
Oct 4	Calm	11 9	−65 3	11,524	E S E
Nov 8	N N E	9 0	60 8	10 504	N W
Dec 6	S S W	0 8	−51 6	9,168	S S W
Jan 14	W S W	5 2	−70 2	12,361	S E
Feb 7	E S E	−6 7	62 0	15,346 and 17,073	S S E

The following details, not included in the above table, are of interest —

April —An inversion occurred between 14,000 metres and 15 000 metres

May —A large inversion occurred above 10,160 metres, at the maximum height, 16,970 metres, the temperature had risen to −42° 0 C Humidity fell to 18 per cent at 10 330 metres, during the descent

June —Above 11,460 metres an inversion occurred up to the greatest height, 15,690 metres, where the thermometer read −54° 5 C Humidity, 22 per cent, at 2520 metres

July —Inversion occurred between 9800 metres and the maximum height, 15,682 metres, where the thermometer read −50° 0 C, humidity, 19 per cent

August —At the maximum height, 18,835 metres, the temperature was −50° 3 C, between 13,800 metres and 18,000 metres there was an inversion in a layer about 4000 metres in depth

September —The meteorograph was broken by collision with buildings at starting

October.—An isothermal zone occurred at about 11,500 metres, and an inversion between 1900 metres and 2000 metres. The minimum humidity was exceptionally low, being 9 per cent. at 4640 metres, and at the highest point (13,971 metres) 13 per cent.

November.—At 12,798 metres the temperature was $-53^\circ \cdot 0$ C., an inversion commenced at about 10,500 metres.

December.—At the maximum height, 11,935 metres, the thermometer read $-31^\circ \cdot 1$ C. An isothermal zone commenced at about 6660 metres, and continued with some fluctuations, until the bursting of the balloon.

January.—The greatest height reached was about 16,545 metres, temperature, $-62^\circ \cdot 3$. An inversion commenced at about 12,360 metres. Humidity, 19 per cent. at about 13,000 metres during the descent.

February.—The minimum temperature ($-62^\circ \cdot 0$ C.) was also recorded at 13,994 metres during the descent. An isothermal zone occurred between 15,346 metres and 17,073 metres (temperature, $-62^\circ \cdot 0$ C.), an inversion then set in, at the maximum height (18,472 metres) the thermometer read $-57^\circ \cdot 5$ C.

These isolated observations confirm the general existence of a stratum of air having a considerable increase of temperature, usually between 10,000 metres and 15,000 metres, referred to by Prof. Hergesell, M. Teisserenc de Bort and others and the opinion that it constitutes a distinct current in the upper regions of the atmosphere.

TERRESTRIAL PHYSICS IN THE UNITED STATES.[1]

IN the first of the publications described in the footnote we have an investigation of the figure of the earth as determined by operations in the United States. The deflection of the vertical at each station due to all known topography within 4126 kilometres of the station has been computed. Least-square solutions, based on all the observations, were made (1) on the supposition that the earth is rigid, (2) solutions on the hypothesis of isostacy corresponding to three different assumed depths at which the isostacy is supposed complete, (3) a similar solution on the usual hypothesis, that there is no relation between the observed deflection and the topography.

The authors direct the attention to the "particular method of attack," first, of those whose chief interest is in the figure and size of the earth, secondly, of those who believe that the condition of isostacy exists, and thirdly, of those who may, for any reason, have positive belief that cannot be reconciled with the existence of isostacy, inviting an investigation of the methods used.

Isostacy is thus defined:—"The excess of material represented by that portion of the continent which is above sea-level will be compensated for by a defect of density in the underlying material," the ocean being regarded as a defect of mass, and the corresponding compensation as effected by an excess of density in the underlying material.

The conclusions reached have been:—

(1) For the United States, the equatorial radius of the earth is 6,378,283 metres, the polar semi-diameter, 6,356,868 metres, the reciprocal of flattening, 297.8.

(2) Extreme rigidity is far from the truth. Isostacy is a comparatively close approximation. The States are in the main "buoyed up, floated, because of deficient density."

The isostatic adjustment made use of in the report is simply $\delta h = -\delta_1 h_1$, where h is the height of the surface above sea-level, δ its density, h_1 the depth of compensation below sea-level, and δ_1 the defect of density, h_1 being assumed a constant for each of the solutions in (2). This assumption is, of course, a crude one, though it facilitates the calculations, but it is sufficient to bear out the main contention that isostacy must be taken account of in determining the figure of the earth, and that the hypothesis of rigidity is untenable.

In the second of the above publications Mr. Hayford gives a general summary of the results of the survey as regards isostacy. He tells us that the evidence shows clearly and decisively that complete isostatic compensation within a depth of seventy-one miles is near the truth. The main impression which he endeavours to make upon his audience is that the earth is "a failing structure." The idea that the permanence of continents is due to elastic expansion of all the underlying material, as viewed in the light of geodetic evidence, he regards as extremely absurd, "whereas the earth is apparently inelastic to a high degree, even near the surface, and is apparently failing continuously," as shown by the ready adjustment of the figure to the effects of denudation. The author attributes the diminution of density beneath elevated regions to chemical changes caused by increase of pressure, but there is no allusion in either of these publications to the theory due to Airy, and described in Clarke's "Geodesy," that elevated tracts are hydrostatically supported by a protuberance of the crust, dipping down into a denser medium below—a mode of isostatic compensation much in accordance with the compressed condition of most mountainous districts.

[1] (1) "Geodetic Operations in the United States, 1903-6. A Report to the Fifteenth General Conference of the International Geodetic Association." By O. H. Tittman and John F. Hayford. Pp. 45. (Washington: Government Printing Office, 1906.)
(2) "The Geodetic Evidence of Isostacy, with a Consideration of the Depth and Completeness of the Isostatic Compensation and of the Bearing of the Evidence upon Some of the Greater Problems of Geology." By John F. Hayford, C.E. (Proceedings of the Washington Academy of Sciences, May 18, 1906.) Pp. 40. (Washington, D.C.: Published by the Academy, 1906.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is reported from Ottawa that the engineering building of McGill University, Montreal, was completely destroyed by fire on April 5, the loss thus involved amounting to 150,000*l*.

THE Carnegie Institute at Pittsburg is to be dedicated this afternoon, and the ceremonies in connection with the event will continue until Saturday, when honorary degrees will be conferred by the University of Pennsylvania on a number of the foreign visitors. The *Times* correspondent at New York states that the gift of 1,200,000*l*. for an additional endowment and building fund for the institute, announced by Mr. Carnegie last week, makes the total sum given by him for the institute and for technical schools in Pittsburg more than 3,400,000*l*., while the technical schools can draw on him for 1,400,000*l*. more as money is needed. Mr. Carnegie's total contributions to Pittsburg and Allegheny now amount to more than 6,400,000*l*. So far as is known his total donations for public purposes in America and Europe amount to the stupendous sum of 33,300,000*l*. Of this total 10,800,000*l*. have been given in the last four years.

THE *London University Gazette* announces several courses of lectures for advanced students of science by university teachers. Among these may be mentioned eight lectures on "The Ancestry of Angiosperms," by Miss Ethel Sargant, at University College, on Mondays, beginning on April 29. Nine lectures on "Psychological Research in Schools" will be given on Fridays, beginning on April 26, lectures i.–iii. and vii.–ix. will be given by Miss B. Edgell, lecture iv. by Dr. A. D. Waller, F.R.S., and lectures v. and vi. by Mrs. Reid. Four lectures on "The Pineal Sense Organs and Associated Structures in the Vertebrate Brain," by Prof. Arthur Dendy, on Tuesdays, beginning on May 7, in the physiology lecture theatre, King's College. Twenty lectures in protozoology at the Lister Institute, Chelsea, by Prof. E. A. Minchin, on Mondays, Wednesdays, and Fridays, beginning on Wednesday, May 1; each lecture will, when possible, be followed by exhibits of microscopic preparations illustrative of the subject of the lecture. Dr. W. N. Shaw will resume his lectures on dynamical meteorology on Monday, April 29, in the physics theatre, University College. The course will be continued on Fridays and Mondays until Friday, May 17, inclusive.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 13, 1906.—"Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases." By F. W. **Aston**. Communicated by Prof. J. H. Poynting, F.R.S.

This paper deals with experiments on the length of the "Crookes" dark space under steady currents in air, oxygen, nitrogen, and hydrogen, and its relation to pressure, current density and potential in a cylindrical glass discharge tube the electrodes of which are large aluminium discs closely fitting the tube. Under these conditions it is found that so long as the current is kept above a certain value, *i.e.* sufficient to cover the kathode with glow and to cause the complete disappearance of the positive light on the anode, the distance between the electrodes has quite a negligible effect upon the dimensions of the dark space, the current, and the potential. The current ceases abruptly, however, when the length of the dark space becomes the same as that distance; also the negative glow terminates sharply (in the case of oxygen amazingly so) over the greater part of its area at a plane exactly parallel to the kathode at a distance from it (D) accurately measurable by means of a simple sighting arrangement. In order to eliminate edge effects and to get a more exact measure of current density, the kathode used was in the form of a disc and guard-ring, that current passing through the disc only being measured. If P = pressure, c = current density, V = potential between electrodes, then very approximately

$$D=\frac{A}{P}+\frac{B}{\sqrt{c}} \qquad V=\frac{F\sqrt{c}}{P}+E,$$

A, B, F, and E being constants for a given gas, the last being very nearly the same as the accepted values of kathode fall with aluminium electrodes in the gas.

These empirical relations, together with other observations, led to the conclusion that *the dark space may be regarded as a region of positive electrification travelling towards the kathode, in which the total positive charge exactly balances the negative charge on the kathode.* The theoretical fall of potential across such a region in which the density of negative electrification is assumed negligible is shown to be $\left(\frac{8\pi c}{\lambda}\right)^{\frac{1}{2}}\frac{2}{3}D^{\frac{3}{2}}$, where λ is the velocity of a positive ion in a unit field and c is the density of the current carried by the positive ions, so that if the latter bear a constant relation to the whole current density passing through the tube, we should expect cPD^3V^{-2} to be a constant for any gas. This is found to be the case for all values of the dark space between 0.5 cm. and 2.0 cm. in the gases under investigation. From the values so obtained the velocities of positive ions at the very low pressures (of the order of 0.2 mm. mercury) employed are calculated, and shown to be of the order expected from the values at atmospheric pressure determined by Zeleny. The stream of positive ions may be strikingly shown by a rotatory mica mill mounted *inside* the dark space, which rotates violently in the *opposite* direction to the familiar ones designed to show the motion of kathode rays away from the electrode. Suggestions are put forward to account for the almost incredible "sharpness" of the edge of the negative glow in oxygen, the most remarkable phenomenon of the investigation.

Mineralogical Society, March 19.—Prof. H. A. Miers, F.R.S., president, in the chair.—The silver deposit of Sedgman lode in the Perran Mine, Cornwall: F. H. **Butler**. The lode runs through killas in an approximately north and south direction. The silver ore, consisting almost solely of cerargyrite, occurs in compact masses or finely disseminated in a gossany limonite. Splintery and ferruginous quartz, the "cab-course," is always a well-developed feature in the richest parts of the lode. The distribution of the cerargyrite, to the depth of 18 fathoms to which the mine has been worked, is roughly in accordance with the surface contour of the land, but segregations have also taken place along a series of lines running from above downwards. The source of the chlorine, the author suggests, might be sea water that has reached [illegible] regions.—The minerals of the Silvermines District, Co. Tipperary: A. **Russell**. The mines extend along an east and west line of fault in which Silurian, Old Red Sandstone, and Carboniferous rocks are brought into juxtaposition. Along its course in certain places mineralisation has taken place, resulting in contact lodes and metasomatic deposits. In the Ballygowan South mine is an interesting occurrence of hemimorphite, the only one of the kind known in the United Kingdom. The mineral is found in brilliant crystals lining cavities in limonite. The gossan also contains irregular masses of argentiferous galena, partially altered to cerrusite. At the Ballynoe mine, copper pyrites, galena, and barytes form a lode between walls of Silurian and Carboniferous limestone. At the Gortnadyne mine argentiferous tetrahedrite is found with copper pyrites and cerrusite ("cat-tooth ore"). An extensive series of old open workings of galena can be seen at the Shallee East mine.—Baddeleyite from Ceylon: G. S. **Blake** and G. F. Herbert **Smith**. Three brilliant crystals of the mineral were picked out from a number of specimens of the heavy minerals from the gem district of Ceylon which were sent to the Imperial Institute in 1905. Of the three crystals, one possessing only the prism zone was used for analysis, and found to contain nearly 99 per cent. of zirconia. On the other two crystals, one of which was a twin, were observed eleven forms, including one new one (210).—Zinciferous tennantite from the Binnenthal: R. H. **Solly** and G. T. **Prior**. Crystals of tennantite, one of which was a large cube, with faces deeply striated parallel to small tetrahedral faces, were found on analysis to contain nearly 8 per cent. of zinc.—Strüverite, a new mineral: F. **Zambonini** and G. T. **Prior**. This new mineral was found in detrital masses of pegmatite near Craveggia in N. Piedmont. Crystallographically it is very similar to rutile and tapiolite, with axial ratio $a:c = 0.6456$. Some of the crystals are elongated along the pyramid edge, and are probably twins similar to those of ilmenorutile. The mineral is black and opaque, and has a specific gravity of 5.59. It contains titanic acid, zirconia, oxide of iron, and niobic and tantalic acid. The result of analyses suggests the formula

$$3FeO(TaNb)_2O_5.4ZrO_2.9TiO_2,$$

which may be written as a mixture of the three molecules $Fe(TaNb)_2O_6$, $FeZr_2O_5$, and $TiTi_2O_6$ in the proportion of 1:2:3. Chemically it is very similar to ilmenorutile, but contains about 28 per cent. of ZrO_2 replacing part of the TiO_2.

Zoological Society, March 19.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Recently discovered subfossil Prosimiæ from Madagascar, and their affinities with extant lemurs and with the higher Primates: H. F. **Standing**. The remains were obtained in the muddy bed of a swamp formed by the blocking up of the river Mazy by a lava flow, at from a few inches to 3 feet or 4 feet below the surface. They consisted of a large number of skulls and limb-bones of lemurs and lemur-like animals. This great amount of material enabled the author to corroborate the view, previously put forward by Dr. Forsyth Major, that the extinct lemurs of Madagascar were, in many respects, intermediate between existing lemurs and monkeys, and to express his belief that the New World monkeys and the Lemuridæ, as well as the Malagasy Indrisinæ, had a common origin. He also stated his opinion that it was not possible to separate the Primates, as hitherto, into the two suborders Lemuroidea and Anthropoidea.—Animal parasites: Dr. L. W. **Sambon**. Three new species were described:—*Wellcomia mitchelli*, gen. et sp. nov., habitat, small intestine of *Pedetes caffer*; *Sparganum baxteri*, sp. n.? habitat, connective tissue of man; *Schistosomum mansoni*, sp. n., habitat, blood-vessels of man. Dr. Sambon also described five new Hæmogregarines discovered by Dr. C. G. Seligmann and himself in snakes.—A collection of mammals, the seventh of the series, made by Mr. C. H. B. Grant at Coguno, Inhambane, and presented to the National Museum by Mr. C. D. Rudd: Oldfield **Thomas** and R. C. **Wroughton**. The collection consisted of 212 specimens belonging to thirty-nine species, of which six were described as new.

Entomological Society, March 20.—Mr. C. O. Waterhouse, president, in the chair.—Dr. F. A. Dixey exhibited several species of Phrissura and Mylothris, illustrating the remarkable parallelism between different forms of the two genera, a correspondence believed by the exhibitor to have a mimetic significance, the mimicry being probably of the Müllerian kind.—The following papers were communicated:—Studies of the Tetriginæ in the Oxford Museum: J. L. Hancock.—A list of the Coleoptera of the Maltese Islands: M. Cameron, R.N., and A. Camana.—The life-history of *Spindasis lohita*, Horsf.: J. C. Kershaw.—The egg cases and early stages of some South China Cassididæ: J. C. Kershaw and F. Muir.—The life-history of *Tessaratoma papillosa*, Thunb., with notes on the stridulating organ and stink gland: F. Muir and J. C. Kershaw.—The vinegar fly (*Drosophila funebris*): E. E. Unwin.—The structure and life-history of the holly fly: Prof. L. C. Miall and I. H. Taylor.—Note on *Xanthorhoë ferrugata*, Clerck: L. Doncaster.

Chemical Society, March 21.—Sir Henry E. Roscoe, F.R.S., past-president, in the chair.—Synthesis of polypeptides: E. Fischer. Continuing his work on the synthesis of polypeptides, the author has prepared an octadecapeptide containing fifteen glycocoll and three *l*-leucine residues.—Organic derivatives of silicon, part iii., *dl*-benzylmethylethylpropylsilicane and experiments on the resolution of its sulphonic derivative: F. S. Kipping. *dl*-Benzylmethylethylpropylsilicane is sulphonated by sulphuric acid at about 130°, yielding a mixture of acids, of which two, benzylethylpropylsilicolsulphonic acid and *dl*-benzylmethylethylpropylsilicanesulphonic acid, were isolated in the form of their *l*-menthylamine salts.—The reduction of carbon dioxide to formaldehyde in aqueous solution: H. J. H. Fenton. By the action of metallic magnesium on an aqueous solution of carbon dioxide, recognisable quantities of formaldehyde can be obtained, and the amounts formed are considerably increased in the presence of weak bases.—The mechanism of the rusting of iron: G. T. Moody. An experiment was described and shown which proved that in the formation of iron rust the metal must actually first pass into solution, and hence confirmation is obtained of the view that an acid, *e.g.* carbonic acid, is an essential factor in the rusting of iron.—Influence of non-electrolytes and electrolytes on the solubility of sparingly soluble gases in water: The question of hydrates in solution: J. C. Philip. The influence of non-electrolytes and electrolytes on the solubility of gases may be interpreted by supposing (1) that the non-solute takes no part in the absorption, and (2) that hydration of the non-electrolyte or electrolyte may occur, and the solvent thus attached is no longer free to absorb the gas.—A new class of organo-metallic compounds. Preliminary notice: Trimethylplatinimethyl hydroxide and its salts: W. J. Pope and S. J. Peachey. The chlorides of iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, iridium, platinum, and gold react vigorously with magnesium methyl iodide; trimethylplatinimethyl iodide, the corresponding hydroxide nitrate, chloride, bromide, and cyanide have been prepared by this means.—Some compounds of guanidine with sugars, part i.: R. S. Morrell and A. E. Bellars.—The action of aluminium chloride on naphthalene. Formation of $\beta\beta$-dinaphthyl, tetranaphthyl, and tetramethylerythrene: Miss A. Homer.—Mercurous hyponitrite: P. C. Rây.—The decomposition of mercurous and silver hyponitrites by heat: P. C. Rây and A. C. Ganguli. From the results obtained the authors are of opinion that these salts have both an oxylic and imidic constitution.—Studies in optical superposition, part iii.: T. S. Patterson and J. Kaye. The results of observation of the rotation of *l*-menthyl diacetyl-*l*-tartrate, both in the homogeneous state and in solution in ethyl alcohol, benzene, and nitrobenzene, taken in conjunction with those previously published (Trans., 1905, lxxxvii., 33; 1906, lxxxix., 1884), furnish thoroughly valid evidence as to the untenability of van 't Hoff's assumption regarding optical superposition.—An extension of the benzoin synthesis: R. W. L. Clarke and A. Lapworth. Benzylideneaniline hydrocyanide condenses with carvone and with benzylideneacetophenone to form respectively phenylimino-β-benzoyldihydrocarvone and γ-cyano-α-benzoyl-γ-anilino-$\beta\gamma$-diphenylpropane.—Interaction of starch and carbon disulphide. Xanthogenic esters of starch: C. F. Cross, E. J. Bevan, and J. F. Briggs. Starch moistened with the disulphide and then treated with a sodium hydroxide solution is brought into the condition for quantitative reaction and conversion into the xanthogenic ester (sodium salt).—The estimation of small quantities of nitrogen peroxide: R. Robertson and S. S. Napper. The method depends on the changes observed in the characteristic absorption spectrum of nitrogen peroxide as its concentration in dilute mixtures is increased.—The evolution of nitrogen peroxide in the decomposition of guncotton: R. Robertson and S. S. Napper.—An isomeric change of dehydracetic acid: J. N. Collie and I. P. Hilditch. If sulphuric acid of about 85 per cent. instead of about 90 per cent. is allowed to act on dehydracetic acid, the yield of triacetic lactone is much diminished. The by-product formed is pyronecarboxylic acid,

$$\begin{array}{c} CH_3C - O - C\,CH_2CO_2H \\ \| \qquad\qquad \| \\ HC \;\; CO \;\; CH \end{array}$$

PARIS.

Academy of Sciences, March 25.—M. A. Chauveau in the chair.—The approximate theory of the flow over a vertical weir, with sharp edge, without lateral contraction and in a free sheet: J. Boussinesq. A further approximation of a formula arrived at in a previous paper. The results are in accord with the experimental figures of M. Bazin.—Contribution to the study of phosphorescence: Henri Becquerel. The images of two specimens of the same phosphorescent salt, one being at the ordinary temperature and the other at the temperature of liquid air, were thrown simultaneously on the slit of a spectroscope. The changes thus noted for several uranium salts in the phosphorescent spectra are given in detail. The increased sharpness of the bands at the lower temperature enabled the polarisation effects to be studied. Those salts of uranium which can be obtained in well-defined crystals, cooled to the temperature of liquid air and illuminated with violet light, show no change in the spectrum when the incident light is polarised, but a change in the spectrum is observed if a Nicol is interposed between the phosphorescent crystal and the spectroscope.—A generalisation of the movement of Ponsot: L. Lecornu.—The coefficient of resistance of air to be adopted in calculations regarding aeroplanes: F. Ferber.—Rotatory magnetic polarisation in the neighbourhood of absorption bands. The magnetic rotatory power of crystals at the temperature of liquid air: Jean Becquerel.—The theory of the radiation of incandescent mantles: M. Foix. It is shown that the sole function of the thorium oxide is to form a support for the cerium oxide.—The influence of the surrounding temperature on the luminous intensity of an incandescent electric lamp: F. Laporte and R. Jouaust. A theoretical investigation of the effect of increase of temperature on the luminous intensity of an electric lamp shows that for a rise of 100° C. in the temperature of the lamp an increase in the luminosity of 0.4 per cent. might be expected. Direct experiment showed that the light remained constant for a rise of 100° C., and as the experimental error was of the order of 1 per cent., this is in agreement with the theoretical figure.—The supplementary channelling of spectra produced by parallel gratings: Georges Meslin.—The function and the nature of the initial discharge in the electric spark: G. A. Hemsalech.—The formation of ammonia gas from its elements under the influence of the electric spark; the influence of pressure: F. Briner and E. Mettler. The concentration of ammonia gas formed by electric sparks in a closed vessel attains a limit of about 3 per cent. to 4 per cent. at the ordinary temperature. If, however, the reaction vessel has its lower end placed in liquid air, the ammonia is condensed as fast as it is formed, and the reaction becomes complete. Working in this way and starting with a mixture of nitrogen and hydrogen in the correct proportions a nearly total vacuum can be obtained in the apparatus. A curve is given showing the effect of pressure on the yield, a pressure of 100 mm. of mercury was found to be the most favourable, the yield being 0.17 gram of

ammonia per kilowatt hour.—The age of the calcareous strata in the neighbourhood of Athens: Const. A. **Ktenas**.

April 2.—M. A. Chauveau in the chair.—The calculation of the inferior contraction of the sheet flowing over a weir with sharp edge and moderate height, and fitted with a horizontal plate above: J. **Boussinesq**.—An extension of the summation method of M. Borel: A. **Buhl**.—The nature of the body extracted from certain rich alloys of nickel and tin: Em. **Vigouroux**. Following the methods described in a previous paper the substance NiSn has been isolated as a crystalline powder, showing brilliant facets under the microscope. It is non-magnetic, and has a density of 8.44, the density calculated from its composition on the assumption of no contraction being 7.03.—The influence of manganese salts on alcoholic fermentation: L. **Kayser** and H. **Marchand**. The increased yield in alcohol resulting from the addition of minute proportions of manganese salts has been shown in a previous paper. It is now shown that yeast thus treated preserves its acquired properties through several generations, and the practical applications of this fact are indicated.—Rectal gills in the larvæ of *Simulium damnosum*. The adaptation of a larva of Simulium to life in the streams of equatorial Africa: E. **Roubaud**.—The nephro-poietic activity of the blood and of the kidney in the course of the renal regenerations: P. **Carnot** and A. **Lelièvre**.—The evolution of carbon, water, and ash as a function of the age in plants: J. **Tribot**.—Some seismic constants deduced from the earthquake of April 4, 1904: E. **Oddone**.

DIARY OF SOCIETIES

THURSDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—The Birth and Affinities of Crystals: Prof. Henry A. Miers, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—A Theorem in the Theory of Functions: Dr. H. F. Baker.

FRIDAY, APRIL 12.

ROYAL INSTITUTION, at 9.—Conservation of Historic Buildings and Frescoes: Prof. A. H. Church, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Engineer's Visit to Japan and Canada: R. W. Allen.

MALACOLOGICAL SOCIETY, at 8.—Notes on New Zealand Polyplacophora, with Descriptions of Five New Species: H. Suter.—Descriptions of New Mollusca from New Caledonia: G. B. Sowerby.—Some New Species of Drymæus from Peru, Mexico, &c.: S. I. Da Costa.—A New Species of Vallonia from India: G. K. Gude.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Continued discussion*:—Petrol Motor Omnibuses: W. Worby Beaumont.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Early and late Perseids: W. F. Denning.—Determinations of Personal Equation depending on Magnitude made with the Transit Circle and the Heliometer at the Royal Observatory, Cape of Good Hope: Sir D. Gill and S. S. Hough.—Determination of the Secular Perturbations of the Minor Planet Ceres, arising from the Actions of the Eight Major Planets: C. J. Merfield.—The Electric Arrangements of an Observatory: W. F. Cooke.—*Probable Papers*: The Perturbations of Halley's Comet: P. H. Cowell and A. C. D. Crommelin.—On the Value of the Solar Parallax from the Greenwich Photographs of Eros, 1899–1900: Royal Observatory, Greenwich (Communicated by the Astronomer Royal).

SATURDAY, APRIL 13.

ROYAL INSTITUTION, at 3.—Studies in Magnetism: Prof. Silvanus P. Thompson, F.R.S.

MONDAY, APRIL 15.

SOCIETY OF ARTS, at 8.—Detergents and Bleaching Agents used in Laundry Work: Prof. Herbert Jackson.

TUESDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Wings and Aëroplanes: Prof. G. H. Bryan, F.R.S.

SOCIETY OF ARTS, at 8.—Joinery and Furniture Making: A. Romney Green.

ROYAL STATISTICAL SOCIETY, at 5.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Note on some Palæolithic and Neolithic Implements from East Lincolnshire: S. H. Warren.—Exhibition of Flints from Cornwall: A. L. Lewis and S. H. Warren.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Pyrmont Bridge: P. Allan.—Swing Bridge over the River Avon at Bristol: W. H. B. Savile.

WEDNESDAY, APRIL 17.

GEOLOGICAL SOCIETY, at 8.—The Toadstones of Derbyshire, their Field Relations and Petrography: H. H. Arnold Bemrose.—Data bearing on the Age of Niagara Falls: Prof. J. W. W. Spencer.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Podura Scale: E. M. Nelson.—Exhibition of Slides of Foraminifera: A. Earland.

SOCIETY OF ARTS, at 8.—Aërial Navigation: Major B. F. S. Baden Powell.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Phenomenal Rainfall in Suva, Fiji, August 8, 1906: R. I. Holmes.—Temperature around the British Islands in Relation to the Gulf Stream: R. Strachan.—Weather regarded as a Function of Climate: L. C. W. Bonacina.

THURSDAY, APRIL 18.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Reciprocal Innervation of Antagonistic Muscles. Tenth Note: Prof. C. S. Sherrington, F.R.S.—Fatty Degeneration of the Blood: S. G. Shattock and L. S. Dudgeon.—(1) The Rate of the Assumption of Chloroform by the Blood during Anæsthesia; (2) Function of the Red Corpuscles in Chloroform Anæsthesia: G. A. Buckmaster and J. A. Gardner.—The Fermentation of Glucosides by Bacteria of the Typhoid-coli Group, and the Acquisition of New Fermenting Powers by *Bacillus Dysenteriae* and other Micro-organisms: F. W. Twort.

ROYAL INSTITUTION, at 3.—The Birth and Affinities of Crystals: Prof. Henry A. Miers, F.R.S.

LINNEAN SOCIETY, at 8.—On the Œcologic Functions of Stolons and Cleistogamous Flowers: J. C. Shenstone.—On the Œcologic Aspect of Constitutional Variation in Fruit culture: A. O. Walker.—On an Aberrant Form of Coccidæ: Hugh Scott.—Some Results of Inoculation of Leguminous Plants: Prof. W. B. Bottomley.—*Exhibits*: Naked Barley and other Cereals cultivated at High Altitudes in Tibet: Dr. George Henderson.—Photographs of Sections of Woods: J. A. Weale.—Lantern Slides of Witches' Brooms: J. Saunders.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Flexibles, with Notes on the Testing of Rubber: A. Schwartz.

CHEMICAL SOCIETY, at 8.30.—The Magnetic Rotation of Hexatriene, CH_2:CH.CH:CH.CH:CH_2, and its Relationship to Benzene and other Aromatic Compounds, also its Refractive Power: Sir W. H. Perkin.—Aromatic Azoimides, Part i., *p*-Hydroxyphenylazoimide: M. O. Forster and H. E. Fierz.—The Action of Hydrogen Peroxide on Potassium Cyanide: O. Masson.—The Action of Ethyl Oxalate on Thioacetanilide and its Homologues: S. Ruhemann.—Measurements of the Velocities of Saponification of the *l*-Menthyl and *l*-Bornyl Esters of the Stereoisomeric Mandelic acids: A. McKenzie and H. B. Thompson.—Indican. Preliminary Notice: A. G. Perkin and W. P. Bloxam.—Cupric Nitrite: P. C. Rây.—The Constituents of the Essential Oil of American Pennyroyal. Occurrence of a Dextro-Menthone: M. Barrowcliff.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Acetoacetate: T. E. Gardner and W. H. Perkin.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 9.—Nerve as a Master of Muscle: Prof. C. S. Sherrington, F.R.S.

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THURSDAY, APRIL 18, 1907.

METEOROLOGICAL OPTICS

Meteorologische Optik By Prof J M. Pernter In three parts. Pp 558 (Vienna and Leipzig W. Braumüller, 1902–6)

THE subject of "meteorological optics" has scarcely yet reached recognition as a distinct branch of physical science, as one of which it were desirable that the phenomena should be systematically gathered together in order that the interaction of all the circumstances affecting any one group of appearances might be the more clearly appreciated The various matters which may be legitimately included under such a title have, individually, not failed of their full share of attention and discussion in the nature of the case they have from the earliest times been the subject of curious, though not always careful, observation and speculation, and of most of the phenomena an explanation, at any rate approximate, has already been satisfactorily given The cause of the blue of the sky and of the "twinkling" of the stars, the theory of mirage, of the rainbow, of halos and mock suns, of all these much has been written, and by many physicists of eminence, but an exhaustive classification of all the questions which fall within the domain of meteorological optics has perhaps hardly been attempted

From the optical side, the most complete account of the subject previously given is to be found in Mascart's "Traité d'Optique", but the accumulation of meteorological data has proceeded somewhat more rapidly of recent years, and it is to the meteorologist that we must look for the exact quantitative solution of many problems in which the optical theory has already been correctly indicated Prof Pernter has every qualification for the task which he has set himself, and as director of the Imperial Institution in Vienna for the study of meteorology and terrestrial magnetism he brings to his subject an acquaintance with meteorological data such as few can claim His book will rank as a classic of scientific literature, and is little likely to be superseded, within more than one generation, as the standard work on this branch of natural science

Prof Pernter explains that his work is based on lectures delivered during a period of ten years in the Universities of Innsbruck and Vienna It is, however, singularly free from the defects one is prepared to find in a volume so produced, it is neither too diffuse nor too exclusively technical, and while essentially scientific, in the strictest sense, in its aim of giving an exact numerical explanation of the phenomena recorded, it furnishes a descriptive account of the appearances dealt with, from the records of observations, old and new, which the least scientific reader can scarcely fail to find attractive

Of the contents of the four sections into which the subject is divided the author's own classification is the best guide The first section deals with the apparent forms of the vault of the sky and the phenomena connected therewith—over-estimation of the heights of mountains, the apparent variation in size of sun, moon, and constellations between horizon and zenith, &c In section ii are included all the phenomena which owe their origin to the gaseous constituents of the atmosphere, whether under normal or abnormal conditions—astronomical refraction depression of the horizon, mirage, the "Fata Morgana," and the scintillation of the stars In the third section are considered the effects due to the presence in the atmosphere of masses of particles the appearance of which is intermittent—clouds, whether of ice crystals or rain-drops, and here we find a full discussion of halos and parhelia, coronæ and rainbows The fourth section, which will be issued next autumn, will treat of the phenomena due to the existence in the atmosphere of very minute particles of whatever nature which are always present but which are especially numerous at certain times, as after volcanic eruptions The classification thus indicated is both natural and convenient, with but rare exceptions it brings together all those phenomena which are of similar origin, and therefore demand similar treatment

Of the first section it will suffice to say that Prof Pernter gives a very careful discussion of the apparent form of the "vault" of the sky, basing his numerical results especially on the observations of Reimann His conclusion is that the form is that of a segment of a circle, the arc of which subtends at the centre an angle of the order of 40° From this it follows that estimations of dimensions near the horizon and at higher altitudes will differ widely, a factor having important bearings, is already indicated, in regard to many every-day phenomena to which we may add the apparently oval form of halos and coronæ at low altitudes In his explanation or rather his suggestion, as to the direction in which an explanation must be sought, the author follows Gauss, who first made experiments to show that this subjective effect is mainly due to the normally upright position of the body, and to the abnormal, or at least unusual, procedure involved in raising the eyes from the horizon to the zenith It need hardly be added that there are many points here demanding further discussion

The second section passes from the consideration of the effects due to atmospheric refraction under normal conditions to a very full and interesting account of the various phenomena due to reflection and refraction when the density of successive layers of the atmosphere shows abnormal variations or when the density in any region is subject to rapid fluctuations Prof Pernter is perhaps here at his best For the descriptive portion of the work he has sought the most typical examples to be found in scientific literature, giving in the words of the actual observers the details the explanation of which he afterwards follows out as closely as possible from the most exact data obtainable relative to the variations of atmospheric density We may direct attention especially to the author's theory of cases of exceptional "visibility" of distant objects, apparent nearness and magnification His theory of the

different forms of mirage, whether due to reflection from above or below, or from the side, is essentially that given by Tait in his paper "On Mirage" in the Edinburgh Transactions. Of the "Fata Morgana," two specially interesting examples are cited from observations by Prof Boccara in 1900 and 1901, while of distortion due to abnormal atmospheric refraction the most striking cases are those seen by Arctowski, as quoted from the records of the Belgian Antarctic Expedition

The theory of the scintillation of the stars and planets, and of the analogous phenomena observed in the sun and moon when almost eclipsed, has aroused an exceptional amount of attention, and is here very fully considered Lord Rayleigh has discussed the matter in a paper on the theory of stellar scintillation, where the failure of the "interference" theory as propounded by Arago is made clear The various optical effects in which the phenomenon may be said to consist, the quivering and the fluctuations in intensity and colour, as well as the meteorological conditions, the extent and character of the atmospheric "striæ," with the best methods of observation and measurement, are most completely dealt with in the papers by Karl Exner in the *Sitzungsberichte* of the Vienna Academy of Sciences and elsewhere Prof Pernter accepts what he designates the Montigny-Exner theory as giving a complete and exact explanation of the whole phenomenon

The theory of halos, of parhelia and anthelia, and allied phenomena given in the third section of the book is founded on the classical work of Bravais "Sur les Halos," which dates from the middle of last century Though Prof Pernter speaks of this theory, elaborated by Galle and Bravais as giving an entirely satisfactory and in all main essentials complete explanation of the phenomena, he is yet able, with the greater mass of more exact records of observations at his command, and the more accurate knowledge as to the form and optical characteristics of ice-crystals—six plates of reproductions of photographs of various types of ice-crystals are given—to confirm or correct in many details the earlier theory The rarity of some of the appearances necessarily renders numerical confirmation difficult, and it may be well to note, for example, the desirability of further careful observations of the "schiefe Bogen von Lowitz," the lateral arcs tangential to the halo of 22°, and of the parhelia related to the halo of 46°, especially the colour effects when the sun is in the horizon The whole discussion is fully and clearly given, and is very suggestive of the possibilities of further meteorological research

The author next deals with the phenomena due to diffraction effects, whether seen directly by transmitted light or by reflection—coronæ, the "Glory" or "Brockengespenst," iridescence of the clouds, &c—with an exposition of the theory as developed by Fraunhofer, Verdet, and Exner, and based on Airy's development of an expression for the variation in light intensity in the diffraction image The volume concludes with a complete discussion of the rainbow. Prof Pernter follows the theory of Descartes to the point where its neglect of the consequences of diffraction leaves it inadequate to explain the phenomena, basing his subsequent development on the Airy "*rainbow-integral*" for the intensity of light in the neighbourhood of a caustic.

Prof Pernter suggests that, in a subject of which so much has been written in monograph, his work must necessarily be of the nature of a compilation. He expresses the hope, however, that it may perhaps claim to be more than a mere compilation No one who has read his work with any attention will be likely to question this claim Rather it may be taken as the model of what a standard treatise on a branch of physical science should be, written by one whose researches have done very much to remove difficulties and to lighten obscurities Dealing as it does with matters of absorbing interest, it is unquestionably a book to be read by everyone who takes an interest in the study of natural phenomena.

THE NEW EVOLUTION

Recent Progress in the Study of Variation, Heredity and Evolution By R H Lock Pp xv+299 (London John Murray, 1906) Price 7s 6d net

THE labours of a new school of biologists, ably represented in this country by a band of energetic workers at Cambridge of whom the author of the present book is not the least distinguished, have been of great service both direct and indirect to the study of evolutionary method It was perhaps to be expected that in the first flush of enthusiasm caused by the re-discovery of an important generalisation like Mendel's, judgments should be formed and statements made some of which may seem to pass the bounds of scientific caution, but signs are not wanting that a more restrained attitude is beginning to prevail, and it is a healthy symptom that the free use of the experimental method, rather than mere academic discussion, characterises the work of the new evolutionists

A noteworthy point in the biological movement of the day is the response that is being given in various quarters to the reasonable demand for quantitative treatment of the facts of variation, selection and heredity From the side both of the biometricians and of the Mendelians, statistical evidence is being accumulated and dealt with on a scale that might have satisfied Stanley Jevons himself It must be confessed that the pretensions of these two schools are at present more or less antagonistic to each other and to the convictions of orthodox Darwinians, it is certain, however, that the questions raised in the course of this three-cornered rivalry are of the greatest importance, and that nothing but good can come of their thorough discussion

The book before us gives an elementary but generally clear and skilful exposition of the present aspects of the evolutionary problem. It is the work of one whose sympathies are confessedly Mendelian and mutationist, but who shows a real desire to do justice to the views of opponents. Mr Lock's point of view is far removed from that of certain half-

instructed writers in the lay Press, according to whom natural selection is nothing but a discarded fashion of the mid-Victorian period, as obsolete to-day as the pork-pie hat and the crinoline But he is none the less a disbeliever in the Darwinian account of the origin of species

High as are the merits of Mr Lock as an expositor, there are points, as we think, on which his arguments must fail to carry conviction The phenomena of adaptation we hold to be of supreme importance in the interpretation of evolutionary process It is difficult to exaggerate the extent to which adjustment to the circumstances of life prevails in every department of organised nature This is a fact which the advocates of "mutation" do not fairly face Mr Lock is too candid not to admit that "organic beings on the whole are, as a general rule, very closely fitted for the conditions in which they have to pass their lives" But after adducing certain well-known instances of "animals having peculiar habits, and possessing at the same time special organs which render them well fitted for these habits and no others," he manages to convey the impression that such cases are not very common, and that, considered as evidence of the power of natural selection, the best of them are open to criticism Then, after a sketch of the theories of mimicry and protective resemblance, he adds that it is "uncertain whether this principle [of natural selection] can hold good as the true description of the origin of any sort of resemblance"

"Perhaps a still more serious criticism," he goes on to say, "of the methods of those who spend their time in seeking out or devising cases of adaptation has been made by Bateson, who points out the logical difficulty that we can never make any quantitative estimate of the amount of benefit or the reverse which any particular structure may afford to its possessor" Most biologists will allow that quantitative methods should be used wherever possible for the solution of the problem, and it is curious that Mr Lock should apparently not be aware that there are several instances in which this has been done We do not see where the "logical difficulty" lies, on the question of fact we regret to differ from Mr Bateson, if his opinion is here correctly stated

The underlying idea in all that Mr Lock has to say on the subject of adaptation by selection is the doctrine that specific differences arise by way of "mutation," or *de novo*, and not by the accumulation of continuous or "fluctuating" variations The position is ably argued, and the results of the laborious experiments of de Vries and of the remarkable work of Johannsen are brought to bear with the skilful touch of a genuine investigator who is personally conversant with the matter in hand, nor does Mr Lock's general attribute of fairness here desert him. A point, however, on which we should like to be satisfied is this the author asserts that "no one questions the validity of natural selection as a means of exterminating types which are unfitted for their environment", further, he thinks it at least probable that certain types have survived in consequence of their "fitness." But, since these latter types arose, as he would say, suddenly or discontinuously, how did it happen that they sprang into being in such exact harmony with their surroundings? Would Mr Lock have us fall back upon the theory of "directed variation," or, what comes to the same thing, Paley's view of "contrivance" by special creation? If it be replied that a well-adapted type must have arisen, not by one or more large mutations, but by a series of mutations both numerous and minute, we should wish to know how such mutations are to be distinguished from continuous variations To say, with de Vries, that selection of individual differences is powerless to raise permanently the mean of a species, seems perilously like begging the question As soon as the mean had been permanently raised, the result would be claimed as a mutation

We have space only for one further remark If Mr Lock will take his Aristotle again, and read, with its context, the passage he has quoted on p. 116, we think he will see that he has mistaken that philosopher's meaning, as, indeed, Darwin did before him

F. A D

NOTES ON WATER PLANTS

Biologische und morphologische Untersuchungen uber Wasser- und Sumpfgewächse Part ii By Prof Hugo Gluck Pp xvii+256 (Jena Gustav Fischer, 1906) Price 18 marks

THIS work forms the second instalment of the author's studies on water plants It deals chiefly with the European species and varieties of Utricularia, and, as was perhaps inevitable, one result has been to increase the number of the forms hitherto recognised as distinct A prominent feature of the book lies in the attention devoted to the so-called *Turions*, or propagation buds, which occur so frequently in aquatic phanerogams

Several other aquatic genera also are dealt with, *e g* Ceratophyllum, in which Prof Gluck finds a specialised form of shoot provided with anchoring leaves, much reduced in character, which serve to fix the plant in the mud These leaves differ from the ordinary foliage leaves in the absence of chlorophyll and in the almost complete suppression of the intercellular spaces so characteristic of the latter

The conclusions reached as to the morphological interpretation to be placed on the different parts of the Utricularia plants do not essentially differ from those drawn by Goebel about sixteen years ago as the result of an extensive series of investigations on tropical as well as on European species of this remarkable genus The special feature of interest attaching to them lies in the impossibility of establishing a consistent distinction between the stem and leaf in these plants One can pass into or be replaced by the other in the most irregular manner, and either of them may in turn be represented in position by one of the bladders that form so characteristic a feature of the genus As Prof Gluck remarks, the

morphological distinction so commonly insisted on as between axial and foliar structures is largely the result of preconceived views as to their essentially separate nature, or, as we would prefer to put it, of the general experience that they are distinguishable. But morphological differentiation is really not irrevocable. There are many ways in which the normal (hereditarily transmitted) form may be changed if the sequence of those internal chemical changes that determine the structure at any given time and in any given instance can be interfered with, and this consideration should put us on our guard against the introduction of transcendental ideas into our morphological conceptions.

In the lower plants, in which the sequence of structural change has remained less stereotyped, it is sometimes easy to control the course of development, and within limits, to induce considerable modifications in organisation. As an illustration we may recall the well-known case of the influence of light in determining the dorsiventrality of Marchantia. This plant produces lens-shaped brood bodies or gemmæ, and when these are allowed to germinate, the surface (whether upper or lower), which is illuminated, assumes the structure of the normally dorsal, the less, or non-illuminated surface that of the ventral aspect. The behaviour under experimental conditions of *Aneura ambrosioides*, another liverwort, may also be quoted. This plant forms beautiful tufts or sheets of pinnate thalli, spread over the surface of the wet rocks or banks on which it occurs. But by appropriate methods of cultivation the plants can be made to grow erect, and then the ends of some of the pinnæ turn downwards to grow and ramify in the soil. The change thus induced is not necessarily permanent, and a restoration of the normal environment at once causes further growth to advance along the previous lines. But the interest attaching to such an experiment is enhanced when it is known that there are other nearly allied species the response of which to the influence of the *ordinary* environment takes precisely that form assumed by *A. ambrosioides* as the result of the introduction of certain special conditions. Many other examples of a similar kind will occur to those who are familiar with the results of the so-called "experimental morphology."

In the higher plants a certain degree of latitude of organisation is generally recognised, but its limits do not, as a rule, exceed the chief morphological barriers. The genus Utricularia, however, stands out amongst the flowering plants as one that has pre-eminently broken loose from the trammels of hereditary tradition. The chain of events which in the vast majority of plants are linked together in a sequence so orderly that the final result—differentiation into stem and leaf—seems invested almost with the sanctity of a law of nature is here rudely interrupted. It is to this very circumstance that the Utricularias owe their great importance from the biological standpoint, and any contribution to our knowledge of the group is assured of an attentive reception.

J. B. F.

A NEW ATLAS.

The M. P. Atlas. A Collection of Maps showing the Commercial and Political Interests of the British Isles and Empire throughout the World. Forty plates. (Edinburgh and London: W. and A. K. Johnston, Ltd., 1907.) Price 25s. net.

THIS atlas consists of a series of maps chiefly representing the British Empire. They are very clearly printed, and some of them are decidedly good specimens of cartography. The bathy-orographical map of the British Isles is particularly worthy of notice. It is beautifully clear, and in every way an excellent piece of work. The special feature of this map is the orographical colouring, the effect of vertical relief being obtained by means of a system of colour-tinting in shades of brown, the shades increasing in density with the elevation. The bathymetrical colouring is in shades of blue. As this is such an effective map, it is a pity the same scheme of colouring was not adopted for the other physical maps, as in comparison they, and particularly that of India, are much inferior productions.

Throughout the atlas there is, unfortunately, a lack of uniformity in the style and execution of the maps which detracts in no small degree from their artistic merit. The collection is composed of engraved and lithographed maps, and the contrast between the fineness of the former and the coarser work of the latter is in many instances very pronounced, more especially when examples of the two styles occur on the same sheet, as on Plate 36. This variety in the method of production and certain inconsistencies which are to be found in the maps make it quite obvious that they have not been drawn specially for this atlas, but collected from various sources. There would be nothing to say against this system of using the same maps for different atlases, provided, of course, that they have been completely revised and brought up to the date of publication. But there is a great objection to the inclusion of old, or only partially revised, maps in a new atlas, and there are not a few in the "M. P. Atlas."

Quite a large number of the maps have already appeared in other atlases published by Messrs. W. and A. K. Johnston, most of them in the well-known "Royal Atlas," and many require much more thorough revision to bring them up to the date on the title-page. For instance, on the map of Asia (Plate 20), the physical features are shown exactly as in the same map in an edition of the "Royal Atlas" published fourteen years ago, notwithstanding the considerable alterations and additions recent exploration has made necessary. Then, again, there are railways and political boundaries that require correction. With regard to the latter, attention may be directed to a discrepancy between the boundary of northern Nigeria as shown on the general map of Africa (Plate 29) and on the map of the West African colonies (Plate 34). But no doubt these matters will receive the publishers' attention in revising the atlas for a future edition.

The atlas contains, besides the frontispiece—a bathymetrical hemisphere with London as centre—fifty-three maps. There is a political map of the world in Mercator's projection, and four small world-maps on an equal-area projection showing productions and consumption of foodstuffs, rainfall, and postal delivery. This last map employs a novel method of showing by a system of colouring the number of days taken to convey letters, posted in London, to different parts of the globe where there is a postal service. Next follows a useful series of maps showing steamer routes, railways, and telegraphs. Europe is represented by one general map and fourteen physical, commercial, and political maps of the British Isles. Asia has eight maps, of which India takes up six, the others are a general map of the continent and one of Persia and Afghanistan. The number of maps given to Africa is disproportionally large. In addition to one general and five divisional maps, there are four of the British African colonies, while the Australasian colonies are comprised in three maps—a general map of Australia on two sheets, unfortunately on different scales and in entirely different styles, and a map of New Zealand. With regard to the American continent, there is no general map of Canada, only three fairly large-scale divisional maps, and general maps of North and South America, the latter on two sheets. There is also a map of the North American Transcontinental railways.

The atlas has no index, which much lessens its use as a work of reference.

SOME BOOKS ON CHEMICAL ANALYSIS

Notes on Qualitative Analysis, Concise and Explanatory. By H. J. H. Fenton. New edition, revised. Pp. vi+147. (Cambridge University Press, 1906.)

Church's Laboratory Guide. Revised and partly re-written by Prof. E. Kinch. Pp. xvi+349. (London: Gurney and Jackson, 1906.) Price 6s. 6d. net.

Inorganic Qualitative Chemical Analysis for Advanced Schools and Colleges. By W. S. Leavenworth. Pp. vi+153. (Easton, Pa.: Chemical Publishing Co.; London: Williams and Norgate, 1906.) Price 6s. 6d. net.

Outlines of Qualitative Chemical Analysis. By F. A. Gooch and P. E. Browning. Pp. vi+145. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 5s. 6d. net.

Qualitative Analysis as a Laboratory Basis for the Study of General Inorganic Chemistry. By W. C. Morgan. Pp. xiv+351. (London: Macmillan and Co., Ltd., 1906.) Price 8s. net.

Smaller Chemical Analysis. By G. S. Newth. Pp. 147. (London: Longmans, Green and Co., 1906.) Price 2s.

DR. FENTON'S well-known "Notes on Qualitative Analysis" is a mine of closely-packed practical information which, as the title-page states, is concise and explanatory. A student who works through the book and remembers only half the tests described should be well charged with chemical facts. The ordinary equations are generally used, an equation in terms of the ionic hypothesis being occasionally brought under the notice of the student.

Church's well-known "Laboratory Guide," which has been revised and partly re-written by Mr. E. Kinch, is exactly what its name implies. It is a practical guide to students of agriculture who wish to apply their chemical knowledge to that subject only. It does not pretend to deal with theory, which is left to the lecture-room, and the explanatory part is therefore reduced to a minimum. The book contains a series of exercises on the preparation of simple substances, on qualitative analysis, and, finally, on quantitative analysis, which fills up more than half the book. The simpler preparations being completed, the student is introduced to superphosphates, soils, and manures. Blood and bones and various materials of agricultural interest are dealt with qualitatively and quantitatively. Thus the student is not allowed to feel that he is being caught in the toils of pure science which may lead him anywhere or nowhere; he is, as it were, kept in full view of the farm and in touch with its products. There is very much to be said for this method, provided the scientific foundations are carefully laid. As to the exercises themselves, they are evidently devised and described by an experienced hand.

The volume on "Inorganic Qualitative Analysis" by Mr. Leavenworth is very like other books on the same subject. The directions are clear, correct, and concise—if anything too concise, for the suggestion that a reaction in certain circumstances may fail, is rarely recorded. The more general use of equations and the discussion of theoretical points would have made the exercises more of an intellectual and less of a mechanical process.

Of a somewhat different stamp is the volume by Gooch and Browning. The subject is approached in a more philosophical spirit. The principle of mass action—the basis of all chemical change—is discussed in the introductory chapter. The reactions are expressed by equations, and the conditions affecting precipitation, &c., are carefully indicated. The student is thus made to feel that each step requires a little forethought, that each reagent can only be effective under properly chosen conditions—in short, his intelligence is appealed to. There are several unfamiliar methods introduced, such as the separation of manganese from cobalt, nickel and zinc by means of acetic acid, the use of potassium ferricyanide for distinguishing cobalt and nickel, and the use of amyl alcohol for separating strontium and calcium. The English reader is reminded that "Robin's egg blue," which describes the colour of the manganates, has reference to the American bird. Although the constitution of salts is described under the terms of basic and acidic ions, no attempt is made to develop the subject on Ostwald's "Scientific Foundations", but the usual equations are employed. The book is carefully written, well printed, substantially bound, and may be confidently recommended as quite one of the best of its kind.

The volume on "Qualitative Analysis," by Dr Morgan, is less a work for the beginner than for the student who has already acquired a certain familiarity with experimental chemistry It is, in fact, a comprehensive study of analysis from the theoretical side The author has not merely raised his cap to the new teaching and adopted the old, like some authors referred to in this notice, but has boldly plunged into the ionic hypothesis and consistently adhered to it The book is divided into sections, the first of which deals with general principles, such as mass action, equilibrium, reversible changes, and dissociation, the second section is devoted to reactions of the common elements, arranged according to the periodic system, and the third deals with systematic analysis It is simply and clearly written, although the American spelling and the alternate use of names and symbols in the text are a little confusing to the English reader Nevertheless, the book has a distinct character of its own, it is interesting and suggestive, and will fill a gap in chemical philosophic literature

Newth's "Smaller Chemical Analysis" is an abridged edition of the qualitative section of the "manual," and includes a few quantitative exercises The small edition possesses the characteristic features of the deservedly popular parent volume For the student who is not intending to become a chemist, but who is taking chemistry as an adjunct to other studies, this abridgment will give him a very good notion of analysis He will learn a little manipulation, the use of reagents, and the behaviour of the common metals and acids There is nothing that is really novel in the treatment of the subject A passing reference is made to ionic dissociation, but the theory is not actually applied The figures which are taken from the "manual" are excellent, with perhaps the exception of the drawing of the wash-bottle and blow-pipe, in which the operator's moustache seems to form an essential part of the apparatus

J B C

OUR BOOK SHELF

Animal Micrology Practical Exercises in Microscopical Methods By Dr Michael F Guyer Pp ix+240 (Chicago University of Chicago Press, London T. Fisher Unwin, 1906) Price 9s net.

THE term "micrology" has not received any general acceptance on this side of the Atlantic There seems to be no reason why the term "histology" should be displaced by this more modern word. Though, however, we may take exception to the title of the book, we are not disposed to regard other than favourably the work itself

The study of this book leads to some reflection as to the methods by which instruction in histology can most advantageously be given Manuals of instruction are perhaps generally written so as to act as a *complement* to the teacher's personal directions This book, however, will replace the teacher himself The directions given are so precise and simple as probably to be sufficient to furnish an effective guide to a student with practically no previous training in microscopic work The question is, however, whether there are not disadvantages in this method The defect seems to be that a student using such a book may not have enough scope for his ingenuity and resource It certainly fails to give much stimulus to a student's power in the elaboration of new methods. But as the book is intended by the author primarily for the beginner, and as probably most students using it will adopt it simply to assist them in acquiring a competent knowledge of histological methods without any intention of making use of them in later research, it must be stated that, so far as this objective is concerned, the book is worthy of the highest praise

The general arrangement of the work has no markedly novel features, but the expositions of the methods recommended are admirably clear. The smallest details of procedure are carefully marshalled; and the student is generally left without any opportunity of making a mistake But the instruction afforded is not simply telling the student how the methods are to be carried out, there are added, and this is one of the distinguishing features of the work, explanations of the possible reasons why occasionally failure may occur, and remedies for such failures The author hopes that three classes of workers may be benefited by its use The student in class or the independent individual worker will doubtless profit, but we hesitate to think that a book can be at the same time valuable as an instruction manual for elementary classes and as a general reference book for the teachers of those classes

The crucial test of the value of the work must necessarily consist in the actual experiment of using it in class We venture to think, however, that the volume will react to this test in a most successful manner

Elementare kosmische Betrachtungen über das Sonnensystem und Widerlegung der von Kant und Laplace aufgestellten Hypothesen über dessen Entwickelungsgeschichte By Prof Gustav Holzmüller Pp v+98 (Leipzig B G Teubner, 1906) Price 1 80 marks

THIS little book, in which is summarised the essential parts of a series of lectures given at various times, is another praiseworthy attempt to make the results of mathematical analysis available to those who have not received the necessary preliminary training How far the author has been successful in conveying precise information to this class it is difficult to judge As a rule, it would appear that those who do read such books do not stand in need of the elementary treatment offered, while those for whom the book is intended fail to grasp the nature of the demonstration The author discusses some of the ordinary dynamical problems connected with falling bodies, and also Kepler's laws, as resulting from the operation of a central force. He adds some remarks on perturbations and tidal phenomena, but these sections are necessarily of the most sketchy character There is a very good chapter on the present condition of the sun, written in a popular manner, and in which the author introduces some interesting topics, but here, as in other parts of the book, we would willingly have been spared the quotation of such big numbers, inserted, apparently, with the view of arresting attention Finally, Prof Holzmüller examines the data on which rests the acceptance of the nebular hypotheses as developed by Kant and Laplace We are not disposed to quarrel with his conclusions, which may be stated thus. The hypotheses set up by these philosophers to explain the development of the solar system are inadequate to explain the past history, and furnish unsatisfactory guides for the future They cannot be regarded as a contribution to exact science, but

rather as unhealthy accretions At the same time, the author, following Gauss, has failed to recognise the extreme diffidence with which Laplace put forward his hypothesis By many, the caution and reserve with which Laplace accompanied his suggestions will always be regarded as a model of good taste and evidence of a correct scientific attitude

The New Hygiene. By Elie Metchnikoff Pp viii + 104. (London William Heinemann, 1906) Price 2s. 6d

THIS little book contains the three Harben lectures delivered by Dr. Metchnikoff at the Royal Institute of Public Health last year, an appreciative preface being contributed by Prof Ray Lankester The "Hygiene of the Tissues" is the title of the first lecture, and in it the phenomenon of phagocytosis is discussed at some length, and since this fact is considered to be the principal means of defence of the body against the invasion of microorganisms, and since such drugs as alcohol, opium, and many others impede phagocytosis, it is concluded that their use should be avoided or limited in the treatment of disease, and certain substances such as blood serum and salt solution, which stimulate phagocytosis, employed in certain circumstances In the second lecture, on the hygiene of the alimentary canal, the evil effects of parasitic organisms are dealt with and the use is advocated of sterile food so far as is possible The third lecture deals with hygienic measures against syphilis, and the use of inunction of mercurial ointment as a prophylactic against infection detailed. The book is of extreme interest and one that should be widely read by the educated public

R T H

Synopsis of Mineral Characters Alphabetically arranged for Laboratory and Field Use By Ralph W Richards Pp v+97 (New York John Wiley and Sons, London Chapman and Hall, Ltd, 1907) Price 5s 6d net

THE title of this convenient pocket-book serves to define its scope Emphasis is laid upon crystal form, habit, system, cleavage, hardness, fusion, and solubility in hydrochloric or other acid Definitions of mineral terms and of rocks associated with the minerals included are also provided The arrangement of the matter makes reference to the book easy

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications]*

Anomalous Dispersion and Ionisation

MY criticism of Mr Schott's interesting experiment (NATURE, March 14, p 461) was due to my carelessness in reading his brief account I failed to notice the words "and the tube" in his description of the battery connections, which fact, together with the low voltages which he used, gave me the impression that he employed the current to heat the wire, the ions being derived from the hot metal

The experiment as actually performed is of considerable interest Everything depends upon just what is meant by "the dispersion is completely annulled" I infer that the oppositely curved branches of the spectrum move back into the original straight line, but nothing is said as to whether the gap caused by absorption is filled in The dispersing power of the sodium tube depends upon the density gradient of the sodium vapour, as we pass from the floor to the roof of the tube Anything which interferes with this will alter the dispersion If the discharge stirs up the vapour and renders it homogeneous over each cross-section of the tube, the dispersion will be annulled, while the absorption will remain The nature of the action going on in the tube can probably be learned by looking through the tube at a bright sodium flame, or a gas flame provided with a blue screen which transmits only the region 4600–4900 It will be found that the upper portion of the tube is fairly transparent to the radiations, while the vapour along the floor is quite opaque to them. The effect of the current on the transparency at different levels should be noted

There has always appeared to me to be some mystery about the behaviour of sodium vapour in highly exhausted tubes for it is difficult to see how equilibrium can exist between the dense vapour along the floor and the nearly perfect vacuum along the roof In the light of recent experiments which I have been making, I now believe that I have found the solution of the apparent difficulty The actual density of the vapour along the floor has in all probability been over-estimated It is usual to exhaust the tubes to a pressure of a millimetre or two In all probability, pure sodium vapour at two millimetres pressure is what we should call a very dense vapour (considered optically) Suppose, now, we heat the floor of the tube to the temperature at which the vapour pressure of sodium is equal to the pressure of the residual gas in the tube The density of the sodium vapour considered alone (partial pressure) will depend upon the rate at which it can diffuse through the residual gas to the cooler roof of the tube If the sodium vapour is given off from the molten metal more rapidly than it can diffuse away we may have pure sodium vapour at the surface of the metal, and mixtures of sodium and hydrogen in decreasing proportion as we pass upwards towards the roof, the total pressure being the same at every point however If this is the true state of things, the dispersing power of the tube would disappear if every trace of the residual gas was removed I intend shortly to test this point I have already found that in the long steel tubes such as are used in observing the magnetic rotation of the vapour, the density of the sodium vapour is greatly increased by the admission of hydrogen or air In this case the central portion of the tube is uniformly heated with an electric oven and the sodium distils away to the cooler portions The presence of hydrogen or nitrogen hinders this process the gas holding back the sodium vapour, so to speak and allowing it to acquire a density or rather pressure equal to its own

This way of looking at the state of affairs in the tube may prove helpful in explaining the interesting effects observed by Mr Schott whose further experiments I shall follow with interest

R W WOOD

Baltimore April 2

Positive Streams in "Crookes" Tubes

REFERRING to the abstract of Mr F W Aston's very interesting paper read before the Royal Society on December 13, 1906, "On Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressure in different Gases" published in your issue for April 11 (p 574), may I point out in reference to the therein contained statement that "the stream of positive ions may be strikingly shown by a rotatory mica mill mounted inside the dark space which rotates violently in the opposite direction to the familiar ones designed to show the motion of kathode rays away from the electrode," that in my two papers "On the Circulation of the Residual Gaseous Matter in a Crookes' Tube," read before the Physical Society, and published in the *Philosophical Magazine* for October 1898 I showed similar results, i e that mica mill wheels which turned in one direction under kathode ray bombardment, turned in the opposite direction when so placed as to be just outside of the stream of kathode rays thus indicating a current of particles proceeding towards the kathode, which particles I found to be charged positively?

These results, as stated in my first paper, could only be obtained with extremely high vacua, when no doubt the mica mill wheels were inside the dark space, as is found necessary by Mr Aston

A A CAMPBELL SWINTON

66 Victoria Street Westminster S W April 13

TWO CONTRASTED WESTERN CANADIAN TRIBES[1]

MR HILL-TOUT'S volume fully maintains the standard established by its companions which have already appeared in the "Native Races of the British Empire" series, edited by Mr N W Thomas In clearness and lucidity it perhaps surpasses either of them, for, instead of numberless insufficiently known groups, such as those of Australia, or an inextricable mass of humanity such as crowds British Central Africa, it deals merely with two well-defined linguistic stocks, the Salish and the Déné, occupying clearly marked areas, and characterised by distinct ethnographic features Over the vast area between Hudson Bay and the Pacific Ocean diversity of climate has produced diversity of development, and the introductory chapter describes the geography, flora, and fauna of the region, and gives a brief history of the accounts of the early explorers before proceeding to the grouping of the native races

Rarely can two adjacent districts be found presenting greater physical contrasts than those on the two sides of the coast ranges To the east is the elevated plateau or "dry belt" with a temperature ranging from 110° in the shade in the summer to considerably below zero in the winter, while on the west the climate is like that of the south coast of Devon Beyond the Rocky Mountains extends as far as Hudson Bay a dreary plain of rocks, marshes lakes, and rivers, inclement and unattractive This naturally results in a marked differentiation in the mode of life of the coast Salish from that of the interior Salish, whereas the latter in this respect more resemble the Déné who live to the east of the Rocky Mountains It is interesting to note that among the western Déné, the Loucheux the social divisions seem to owe their origin to an economic variation They are divided into three exogamic divisions or phratries, called respectively Fish people, *Chit-sangh* (=fair), the Animal people, *Nah-t'singh* (=dark), and the Bird people *Tain-gees-ah-tsah* (middle or half-brightish) This seems to be a colour grouping The *Chit-sangh* are very fair in some instances approaching to white, and live largely on fish, the *Nah-t'-singh* live entirely on the flesh of the reindeer, and are very dark-skinned compared with the *Chit-sangh*, while the *Tain-gees-ah-tsah* live on salmon trout and moose-meat, and are neither so fair as the *Chit-sangh* nor so dark as the *Nah-t'-singh*

In spite of local diversity, both Salish and Déné show the "Pan-American" facial features, which are common throughout the whole continent together with a secondary type, approximating to the so-called Mongoloid type, but no other than facial resemblances seem to the author to be common to the whole race

Among psychic characters, the most striking are cowardice and honesty "In point of valour they fall far below the eastern tribes" "The Northern Déné are generally pusillanimous, timid and cowardly," but they are proverbial for their honesty and their hospitality and were in pre-trading days also for their chastity Their folk-tales and tribal traditions

"show us that their lives were moral and well regulated; that deep shame and disgrace followed a lapse from virtue in the married and unmarried of both sexes The praise and enjoyment of virtue, self-discipline and abstinence in young men is no less clearly brought out; whilst respect and consideration paid by the young everywhere to their elders affords an example that more advanced races might with profit copy"

The ethical principles of the Thompson Indians exhibit sound practical morality, and

"People who inculcate such virtues in the minds of their children can scarcely be called debased, or be said to be greatly in need of instruction from ourselves"

If they have fallen away from such high standards the fault is not theirs, but ours "We assumed a grave responsibility when we undertook to civilise these races"

Déné Maids in Native Costume From "British North America I The Far West"

All the main features of native life are well and succinctly described—houses, clothes, food, domestic and warlike implements, customs at birth, courtship, marriage and death, social organisation, and religious beliefs We wish, however, that the section on sociology had been more complete, but the most important omission is that of language, concerning which no information is given, although the author has elsewhere published a good deal on the linguistics of the Salish, on which subject he is an authority

The volume ends with an interesting summary, describing the ordinary life of an average native "From the Cradle to the Grave," a brief and valuable synthesis of the preceding material

"The life of an average Western Indian, as it was lived in the earlier days, was not that of a vicious

[1] "British North America I The Far West the Home of the Salish and Déné By C Hill Tout Pp xiv+263, with 33 full-page illustrations, and 1 map. (London Archibald Constable and Co, Ltd, 1907) Price 6s net

and degraded savage. He had advanced many stages beyond this when we first came into contact with him, and his life, though simple and rude, was on the whole well ordered and happy, and if his wants and aspirations were few, so were also his cares and worries"

The illustrations are numerous and very good, we are told on p 139 that hammers are commonly regarded by the uninformed as pestles, "but this is an error," yet in the description of the accompanying plate they are described as "pestles" and "hammers" It is greatly to be regretted that the utility of this book is restricted by the extremely inadequate "bibliography" (sic) The author's valuable papers in the Reports of the British Association, especially for the years 1899, 1900, and 1902, are not mentioned, neither does he give an exact reference to his own papers in the Journal of the Anthropological Institute No clue is given where can be found, to take only two examples Farrand's excellent paper on the basketry designs of the Salish Indians or the printed MS of Mr B R Ross The single allusion to Prof F Boas is to his work on skull-deformation (reference again omitted) and the series of British Association Reports ending in 1898 is not even mentioned, although the twelfth and final report, with a good index, is of exceptional value The important summary of Canadian ethnology in the Annual Archæological Report for 1905 (Toronto, 1906) contains papers by the author on the coastal Salish, and by Father Morrice on the Dénés, besides other valuable contributions by various authors, and as references are given to the literature the report serves as an admirable text-book on the anthropology of Canada It is strange that no allusion is made to this publication, at all events we recommend students who read Mr Hill-Tout's book to consult the report in order to supplement his deficiencies

THE LEICESTER MEETING OF THE BRITISH ASSOCIATION

THE British Association is assured of a hearty welcome to Leicester for its seventy-seventh annual meeting to be held there from July 31 to August 7, under the presidency of Sir David Gill, K C B, F R S Leicester is a place of great antiquity, few towns in England having a longer history of uninterrupted activity Its Roman remains include the "Jewry Wall," a remarkable example of brickwork, and some mosaic pavement *in situ* The geological features of the district are comprehensive, the Charnwood Forest, with its rocks providing many a geological puzzle, being within a few miles of the town Botanists, too, have a happy hunting-ground there The local committees and sub-committees are working hard to ensure the success of their efforts, and great interest is being shown on all sides in the visit of the association to Leicester A guarantee fund of more than 3300*l* has been raised towards the necessary expenses of the welcome, and this without any public appeal being made No less than eleven amounts of 100*l* and upwards are included in this sum

A call has been made on all the principal halls and public buildings throughout the town for general and sectional use, and it is believed that the arrangements when completed will be most satisfactory in every way The greatest difficulty the executive have had to meet has been the fact that Leicester possesses no town hall or public building large enough for the purposes of the holding of the usual conversazione and general reception of the large number of members and guests anticipated An ingenious suggestion, however, on the part of the chairman of the executive committee (Mr Alfred Colson), which has met with the full approval of all concerned, promises to overcome all obstacles, and even to make the proposed conversazione additionally attractive on account of the unique way in which it will be housed The intention is to utilise the whole of the present museum buildings, including the art gallery and mayoral reception rooms, for the use of which permission has been granted, and to erect on the four sides of the grass square adjoining a loggia or corridor constructed entirely of timber, 25 feet in width forming a covered promenade about 500 feet in length The four outer sides will be closed but the inner sides, overlooking the grass plot, will be open, and so constructed as to be easily beautified with floral decorations Internally the loggia will be draped with incombustible material and fitted with electric light and suitable furniture Besides answering for the reception to be given by the Leicester Literary and Philosophical Society the structure and grounds, with a military band in attendance will make a convenient general rendezvous throughout the week

A further edition of a very interesting work, "Glimpses of Ancient Leicester" by a local author Mrs Fielding Johnson is being issued in connection with this meeting and a handbook by another Leicester lady Mrs Nuttall will be provided The latter book will contain chapters on subjects of scientific interest prepared by various experts specially for the use of visitors

Excursions are being arranged to many points of interest in the district and the Mayor Alderman Sir Edward Wood J P will issue invitations to an evening *fete* in the Abbey Park Sir Samuel Faire J P will give a garden-party and it may be taken for granted that the social side of the meeting will be well provided for The comfort and enjoyment of all attending the meeting will not be overlooked, while the objects of the existence and visit of the association will throughout the week have the first consideration and thought

AN AERONAUTICAL EXHIBITION

THE well-arranged collection of balloon appliances and models of aeroplane systems organised by the Aero Club in connection with the Motor-car Exhibition in London presented a striking contrast to the want of organisation in the aeronautical section of the Milan exhibition of last year The large, almost empty room at Milan with no attempt at systematic display except in connection with the exhibits of the Prussian Government Meteorological Station, has no counterpart in the present exhibition Here everything was well displayed and there was no lack of exhibitors and assistants ready to give information to any inquirer

In studying the exhibits, I paid special attention to the aeroplane models, with the object of ascertaining how far they were likely to furnish material that would further the systematic study of the problem of stability and in particular of longitudinal stability which is the more difficult of study It appears both from theory and experiment, that a very slight change in the form or dimensions, or even in the velocity of propulsion of a model may change its motion from stable to unstable and that if one machine travels safely through the air, another very closely resembling it may overturn at once The general character of the exhibits does not seem to indicate that the constructors of flying models have

really grasped the all-important stability problem, or that the necessity of carefully studying the small oscillations of gliders, both stable and unstable, has been appreciated It seems probable that a great many constructors of would-be flying machines do not even know what is meant by a moment of inertia, yet both theory and experiment tend to show that the stability of a machine depends partly on its moment of inertia being neither too large nor too small

The models exhibited are of various sizes, and adapted for propulsion through the air by means of twisted elastics, like the familiar toys, they are however, of various dimensions, say from about 3 feet to 6 feet The trials which were made at the Alexandra Palace on Monday thus involved none of the dangers attendant on experiments with man-carrying machines It is to be hoped that some means were taken to record the actual motions of the models while in the air Such a record, if made in a way that would enable the positions and the velocities of the models to be plotted at every instant of the motion, could be made to furnish material the study of which will greatly advance our knowledge of the flight problem From what I learnt at the exhibition it appeared that this matter had not received much, if any, attention, but I was given to understand that two kinematographs would be employed to obtain the necessary records The necessity for two is obvious, and I can only hope that the requisite measurements of base line and angles were also attended to

In the following remarks I shall assume the result that a machine supported on aeroplanes has two kinds of longitudinal oscillations of different period, either of which may give rise to instability This is not generally known, but it is desirable to analyse the models even in the light of ideas which are to some extent anticipatory The rough notes taken are far from exhaustive, but they summarise a few points regarding some of the more conspicuous exhibits

Ezio Tani shows a most elegant and beautifully constructed mechanism in connection with the *motor*, the arrangement of wings does not *look* very practicable

Balston and Cochrane both exhibit propellers, &c, of corrugated aluminium

The *avroplane* looks a fairly practicable model The arrangement of two sets of planes tandem fashion appears suited for stability, at any rate so far as the short oscillation is concerned, but a great deal depends on whether the planes are parallel or inclined at a slight angle On the other hand, the increased moment of inertia caused by the projecting framework and the considerable distance between the front and hind surfaces may give trouble with the long-period oscillation

The Drexler model seems to go to the other extreme and suggests that the shortness of base may lead to trouble with the quick-period oscillation Here the planes are superposed, not arranged tandem

Weiss's *albatross* is really a model of a bird with curved wings How far this imitation of the shape of bird's wings conduces to stability cannot be completely studied without further experimental data than are at our disposal The model looks as if it would glide well for a short distance, but without a very careful system of recording, short flights teach us but little

Montford Kay shows a model of great length with propeller placed in the middle of a number of long parallel aeroplanes The arrangement seems ill-calculated for obtaining much lifting force from the air

Piffard shows a reasonable form of model with two pairs of superposed aerocurves, one behind the other As arranged at the exhibition, the combination looked as if it would be unstable for moderate velocities, but a slight change in the inclination of the aerocurves might make all the difference.

T W K Clark shows the most genuine attempt to cope with the problem of stability, he having followed the lines laid down by Chanute in the matter of flexible framework From what I could gather, however, the necessary movements for balancing were not arranged to take effect automatically, but the machine was a small-sized model of a type intended to be balanced and controlled by the dexterity of an aeronaut

It would be impossible from these rough observations to draw any very definite conclusions about the probable results of the competition, but it may be apposite to remark in conclusion that failures may teach quite as much as successes if only they are properly studied G H Bryan.

THE STUDY OF EARTHQUAKES

The Imperial Earthquake Investigation Committee of Japan has supplemented its well-known Publications by a bulletin, issued with the object of securing a quick publication of short notes and preliminary reports on seismological subjects. The series opens with a very interesting number; there are papers on the determination of the time of origin of a distant earthquake, on the methods of calculating the velocities of earthquake propagation, on the Tokyo records of the Calabrian earthquake, and, most interesting of all, a discussion of the cause of the San Francisco earthquake, by Prof Omori, who describes the great fault-fissure, referred to in Nature of June 21, 1906 (vol lxxiv), and notices that near Pt Arena and at some other places it did not show at the surface as a simple fault-fissure, but as a zone of distortion crossed by parallel shear-cracks, from the direction of which he concludes that, besides the relative displacement of the two sides of the fault zone, there was a general compression of the country from north to south This displacement was no mere surface phenomenon, as it appeared in the tunnel near Wright station, some forty miles S S E of San Francisco, at a depth of some 700 feet from the surface From the direction of overthrow of objects, Prof Omori concludes that the whole of the country along the fault has been displaced towards the N.N W, but the west side more than the east

In Austria the collection of earthquake statistics has been taken over from a committee of the Imperial Academy of Sciences by a newly extended Government Institute of Meteorology and Geodynamics The first of the seismological publications of this institute is a catalogue of the earthquakes of the Austrian Empire in 1904, which are detailed province by province with the addition of a general summary. A catalogue of this sort is as important and useful as a collection of meteorological tables, it is little more interesting to read, but, if not pleasant reading in itself, this little pamphlet suggests some interesting if not very comforting considerations. The science of seismology is essentially an English one, it is to Englishmen, and practically to two of them, that most of its fundamental concepts owe their origin, the ideas, which give vitality, and the terms which are in universal use, have almost all been born in this country, yet England remains without any permanent or official organisation for the collection of earthquake information, while one country after another is establishing a special service for this purpose Nor can the neglect be excused by

the plea that the British Government is not concerned in the subject as are those of Japan and Italy, for, if we are fortunately exempt from the visitation of seriously destructive earthquakes, this is not true of our possessions; moreover, as one of the principal suppliers of the materials which will be used in the building of earthquake-proof construction, we have a distinct national interest in earthquakes. In England, too, has been formed the most valuable organisation which exists for the study of those broader aspects of seismology in which the cooperation of widely separated observers is necessary; at more than fifty stations, scattered over the surface of the globe, instruments capable of recording distant earthquakes have been set up, and all report to one central station, where an abstract of their records is periodically published, but this organisation, which we owe to Prof. Milne, is entirely dependent on the energy and initiative of one man, it has no official status or permanent foundation, which will ensure its permanence or extension.

Meanwhile, Germany has been to the fore and instituted an International Seismological Association, which, not content with the holding of periodical meetings, on the model of the international congresses, has established a central bureau at Strassburg, where it aims at concentrating the study of earthquakes and the collection of seismological data. So far its activities have been largely devoted to the preparation of a catalogue of the earthquakes of the whole world, necessarily too incomplete to be of great scientific value, and to the collection, for the purpose of publication, of the seismograms of the Valparaiso earthquake, which, as has been shown in our pages, do not exist in that complete form, uncomplicated by the effect of other disturbances, which is necessary for scientific study. As aids to the advancement of science these count for very little, as advertisements they are invaluable, and in saying this we insinuate nothing against the founders of the International Seismological Association, we may acquit them of any commercial intention, we recognise the great services which its promoter has rendered to science, but the facts remain that, where the information is there will people go for advice, and where they go for advice there too will they obtain their materials, and so we are in a fair way to a repetition of the lesson of the Jena glass.

INDIAN ORCHIDS.[1]

ONE of the largest and most generally distributed of the natural families of Indian plants, the Orchids form at the same time a group in which considerable interest is taken by European residents in our eastern dependency. No order affords more satisfactory data where questions as to the distribution of species have to be dealt with or points connected with endemism require illustration. The value of such data increases as the records for particular areas approach completeness. In order that the records for at least one area might be made as nearly as possible exhaustive, Sir G. King planned, and with the help of Mr. R. Pantling, who made the necessary drawings, carried out a scheme for the description and delineation from fresh material of every orchid known to occur in Sikkim. The results were published in "Orchids of the Sikkim-Himalaya," which forms the eighth volume of the Calcutta Garden Annals.

The present work is, as Mr. Duthie explains, to be regarded as a supplement to that on the orchids of Sikkim. The area dealt with, which comprises the whole of the Himalaya to the west of Nepal, between 70° 30′ and 80° 40′ E., is no doubt much more extensive than the area investigated in the previous volume, which comprises only that part of the Himalaya which lies between Nepal and Bhutan, from 88° to 89° E. But though this be the case, the number of species to be dealt with is much smaller, only 173 orchids are known to occur in the whole north-western Himalaya, as compared with 449 in Sikkim alone, and of these 105 are common to both areas. The same thoroughness has, however, characterised the search for material, and the same care marks the description of the species, though some may regret that the scope of the work has not allowed of fuller criticism in certain places of the work of previous writers. The author has been especially fortunate in having at his disposal the services of a competent artist, Mr. Hormusji Deboo, who has prepared fifty-eight highly satisfactory figures of those species that are to be found in the north-western Himalaya, but that do not occur in Sikkim.

Apart from its value to systematic botanists and students of phytogeography, the work will be welcomed by residents in the hill stations of the north-west Himalaya as the previous volume has been by residents in Sikkim, who in their study of the orchids they meet with find themselves, particularly at first, unable fully to appreciate the characters and relationships of the species before them when they have to rely for information on technical descriptions, however excellent, that are unaccompanied by illustrations. Regret will perhaps be felt that so few plates have been given. It is true that figures of the other 105 species are to be found in the work on the orchids of Sikkim, and it will be realised that the editor of the Annals must have felt himself precluded from incurring the expenditure involved in figuring the same species a second time. Still the fact remains that the figures in the work on the Sikkim orchids, though good, fail to come up to the standard of the work of a trained draughtsman.

The author may be congratulated on the production of a memoir which sustains the character imparted to these Annals by the distinguished botanist who founded the series. The two ideals of scientific accuracy and practical utility aimed at in previous volumes, have been kept steadily in view, and the enlightened liberality of the Government of Bengal, which has rendered their publication possible, will be as gratefully recognised by botanical workers generally as it is by the editor of the Annals in the dedication of the volume before us.

[1] "The Orchids of the North Western Himalaya." By J. F. Duthie. Annals of the Royal Botanic Garden, Calcutta, vol. ix, part ii. Pp. ii+232; with 58 plates. (Calcutta: Bengal Secretariat Press, 1906.)

A RECENT ADVANCE IN THE KNOWLEDGE OF CANCER.

A COMPLETE presentation of the doctrine of the gametoid nature of malignant growths, and of the grounds upon which that doctrine rests, is contained in the first report on the cytological investigation of cancer, recently published.[1] The papers dealing with this subject have appeared in various publications, commencing with the original communication to the Royal Society by Farmer, Moore, and Walker in 1903, and they are here collected together and pre-

[1] University of Liverpool and Royal Infirmary Cancer Research Laboratories (Mrs. Sutton Timmis Memorial Fund). First Report on the Cytological Investigation of Cancer, 1906. By J. E. S. Moore and C. E. Walker. Pp. 87. (Liverpool: Published for the Liverpool Cancer Research Committee by the Priory Publishing Co., n.d.)

faced by an account of maiotic phenomena generally and a detailed comparison of those phenomena with the changes observed in cancer-cells

It will be remembered that the authors of the communication referred to drew a comparison between the nuclear phenomena in cancer-cells and those characterising the process of maturation in the cells of reproductive glands The degree of similarity between the two processes was found to be such as to suggest the inference that the type of cell-proliferation in the two cases was identical, and to those possessing a sense of the morphological significance of nuclear form this conclusion appeared to be warranted

Deviations from the normal mitotic process were, however, already well recognised in cancer-cells, and had been interpreted as being purely pathological phenomena Upon this view the resemblance between the nuclear forms met with in cancer-cells and those encountered in reproductive tissue would be regarded as accidental, and, in particular, the approximate halving of the number of chromosomes in individual cells of a group exhibiting extensive numerical variations both above and below that number would be looked upon as a merely chance occurrence

Before this interpretation could be considered to have been satisfactorily displaced, it was, therefore, necessary to demonstrate that the definite halving of the chromosomes occupies a dominant position in the cancerous process, and to trace in every detail the points of similarity between that process and the maiotic process of reproductive tissue Further research in these directions has tended to strengthen the original contention By constructing the frequency-curve of the numerical variations of chromosomes in cancer-cells the important position occupied by the definite halving of the number of chromosomes has been exhibited in a convincing manner, and the parallelism between the normal maiotic and the cancerous modes of cell division has been traced in such detail as, apparently to leave few points for further comparison

It may, then be confidently affirmed that the cancerous process has now been definitely and accurately referred to its physiological type, and, although the process may deviate from its type in certain particulars marked rather by degree than kind, such as the number of post-maiotic divisions, the validity of the assertion is not thereby affected, since the different circumstances in which the two processes arise must inevitably find expression in corresponding modifications in the processes themselves

A caution is given on p 25 against a too hasty assumption that all gametoid tumours are malignant It is well known that the malignancy of cancerous growths varies in degree in different cases, and that, as regards histological characters, every stage of transition may, in the case of certain organs more especially, be traced in different tumours between structures bearing the distinctive marks of malignancy and such as are undistinguishable from benign growths It is conceivable that at the limit of such a series of transitional forms, tumours may exist which, whilst possessing the features of gametoid growths, are devoid of the properties which denote malignancy The point is one of great theoretical interest, although in practice it is probable that such tumours would be treated as malignant in view of their close relationship to definitely malignant growths The authors however, barely touch upon this aspect of the subject, but suggestions are thrown out which appear to indicate further research into the nature of malignancy and a prospect of substantial results

NOTES

APPARENTLY, the British Government is indifferent to any increase of facilities for the advancement of knowledge, for it makes no attempt to show active interest in organisations and institutions concerned with science and higher education The Carnegie Institute at Pittsburg was dedicated last week in the presence of a large and distinguished company, but neither the British Ambassador nor any member of the British Embassy was present at the ceremony, though invitations were sent On the other hand, the German Emperor was represented by a special commission of six members of the highest rank, France and Italy were also represented, and there were present numerous representatives of other Embassies and Legations It is unfortunate that England should have been without a political representative upon such an occasion, but the omission is only another instance of the failure of British statesmen to understand the significance of anything relating to science or progressive learning The *Times* correspondent states that the absence of British representatives and the consequent tone of the whole proceedings left a regrettable impression among the British and Canadians, who formed a large majority of the foreign guests He remarks —" By Germany an opportunity has been cleverly and quite legitimately seized, by England it has been, by sheer stupidity carelessly neglected " These words could be applied to so many similar instances that they may be considered as describing the characteristic attitude shown by the two countries to scientific work We hope to give an account of the opening of the institute in an early issue.

PROF ROSS contributes a second letter to the *Times* of April 13 on the subject of Mr Haffkine's prophylactic and the Mulkowal disaster We are not so much concerned with the details of the case as with the broad questions suggested by recent occurrences in connection with the steps taken to prevent the spread of plague Prof Ross maintains that the whole story affords another signal instance of the disregard for science so frequently displayed in British administration and the evidence he offers establishes his position He states that in the nine years up to the end of 1905 more than 4,000,000 deaths from plague were recorded in India alone and Prof Simpson says that 20,000 deaths are still occurring there every week Though plague had been raging in Hong-kong for two years before the outbreak in Bombay, the authorities appear to have organised no system of sanitary intelligence, to have investigated few of the cases, and to have had no bacteriological department at hand The result was that when plague appeared all was confusion "No one seemed to understand," says Prof Ross, "that such epidemics can be successfully combated only by the methods which succeed in the case of a military invasion There was no scientific head of the defensive organisation, which was not even centralised until March, 1907. Generals and civilians were made dictators in a matter of which they had no knowledge, and occupied themselves with burning sulphur at street corners, and so on, and then, when these tactics failed, laid the blame on their subordinates, the doctors, whose advice they had frequently ignored and whose science they had habitually despised Everywhere, instead of the knowledge, organisation and discipline which are essential in such emergencies, we saw only nescience, confusion, and vacillation History shows that plague, if taken in time, can be quickly eradicated, and in my opinion the blame for this terrible visitation must be laid largely on those who governed the

country, but neglected until too late the precautions and organisation indicated by sanitary science" It is remarkable that our statesmen learn with such difficulty the value of the application of the methods of science to administrative matters, especially in view of the object-lessons provided by neighbouring nations, lessons sufficient to convince the least thoughtful of the use of science in deciding national difficulties It cannot be repeated too often, in the hope that eventually our legislators and administrators may learn the truth, that the nation which makes the most intelligent use of scientific discoveries and systematically approaches all questions in a scientific manner will assuredly occupy the most honoured place among the peoples of the world

THE Upsala commemoration of the Linnæus bicentenary will take place on May 23–25 The celebrations, which are to be held under the auspices of the University of Upsala, will begin on May 23, in the Aula of the University, with a formal reception of the guests On the evening of the same day a further reception will be held in the University buildings On May 24 there will be a promotion to degrees, only Swedish doctors being promoted It is proposed this year to revive the ancient custom of conferring degrees in the cathedral instead of in the University Aula The evening of May 24 will be taken up by a dinner given to the guests by the University and it is probable there will also be demonstrations on the part of the students On May 25 the Royal Academy of Sciences, Stockholm, will also commemorate the bicentenary in Stockholm All foreign delegates invited by the Upsala University will be provided with free hotel accommodation during their stay in Upsala and Stockholm

MAGNETOGRAPHS of Prof Watson's pattern have been installed recently in the Helwan Observatory near Cairo

MR F F BEDDARD, F R S, has been appointed an honorary member of the New Zealand Institute

M DESLANDRES has been elected president of the Astronomical Society of France for the year 1907–8

THE summer meeting of the British Archæological Association will be held this year in Dorset with Weymouth as the headquarters

THE Croonian lecture of the Royal Society will be delivered by Prof J B Farmer, F R S, on Thursday next, April 25 "On the Essential Constituents of the Nucleus and their Relation to the Organisation of the Individual"

A REUTER message from Mexico states that the towns of Chilpancingo and Chilapa in the State of Guerrero, have been destroyed by an earthquake

THE British Science League and the British Empire League will give a complimentary dinner to the Colonial Prime Ministers at the Whitehall Rooms on Thursday, May 2, at 8 p m

THE annual dinner of the Institution of Mining and Metallurgy will be held at the Hotel Cecil on Friday, May 3 Prof W Gowland, president of the institution, will occupy the chair, and many leading representatives of pure and applied science have accepted invitations to be present

ON Tuesday next, April 23, Prof W Stirling will deliver the first of a course of three lectures at the Royal Institution on "Stimulation, Luminous and Chemical" The Friday evening discourse on April 26 will be delivered by Mr J Swinburne, on "New Illuminants," and on May 3 by Sir James Crichton Browne, on "Dexterity and the Bend Sinister"

THE International Commission of Scientific Aerostation at its last meeting at Milan in October, 1906, resolved, on the recommendation of M Teisserenc de Bort, to carry on during the years 1907 and 1908 the investigation of the upper atmosphere in the northern hemisphere on a much more extended scale than has hitherto been attempted The Royal Meteorological Society has been invited to take part in this scheme, and the council proposes if possible, to organise and equip special stations in different parts of the British Empire north of the equator Unmanned "registering" balloons carrying self recording instruments, and also smaller "pilot" balloons, are to be used, the heights and drift of which will be determined by theodolites The ascents in 1907 are to be made on three consecutive days in each of the months July, September, and November

"BLACK rain" fell in Pembrokeshire on April 10 It was accompanied by a violent thunderstorm and a darkened atmosphere The ominous darkness was observed as far east as Cardiff, but the violent thunder, &c, was confined to districts further west Discoloured rain is also said to have fallen at Carmarthen There have been several such falls in South Wales of recent years One of these occurred round Barry, as well as in the west of England, on January 23 1902, and the matter was carefully discussed by Dr Mill before the Royal Meteorological Society A second fall took place on February 21, 1903 This was more extensive than the other, and the dust differed appreciably from that of the previous fall Analysis of the 1903 dust made at Cardiff College led to the belief that it was probably volcanic Traditional accounts of falls of frogs, snails, and fish occur in the annals of Glamorgan

THE *Daily Chronicle* of April 10 contained the following paragraph —"A thunderbolt fell at Birkenhead yesterday and several persons had narrow escapes from death When a storm seemed about to burst over the town a ball of fire swept over the Bidston Observatory, and struck a mound of earth, whence it rebounded into a field, and set fire to some gorse there A vanman who was near at the time was knocked down and a florist working in his garden was enveloped in a ring of flame and whirled several yards while the spade with which he was working was hurled over the hedge A cow grazing in a field was brought to the ground by the shock, and several workmen in the vicinity, who had trowels in their hands, were considerably alarmed at being knocked off the ladders on which they were working People who were several hundred yards away from the spot where the bolt fell received violent shocks, and were last night suffering from nervous prostration" Inquiries made at the Bidston Observatory with reference to the so-called "thunderbolt" and the amount of damage occasioned, show that there is little foundation for this somewhat sensational report Some of the features associated with the presence of "ball lightning" seem to have been noticed There does not seem to be any evidence that a globe of light was seen, but there were some signs of horizontal motion, and the characters of the after effects resemble those produced by this unexplained phenomenon But the essential mark of slow motion common to "ball lightning" was certainly not noticed and the injury to workmen at some distance though slight, points to the more ordinary effects of lightning

The injuries produced seem to be more nearly akin to those described as lightning strokes in the open field The irregularities of the surface of the land in the immediate district are very slight, and owing to the difficulty that lightning has in striking down upon a smooth plane surface, the boring of a hole in the ground some 2 feet in diameter and 18 inches deep has directed attention to this particular discharge by reason of its unusual character There was no evidence of fused silica near this hole

The Port Erin Biological Station has never been more fully used by workers in marine biology than during the present Easter vacation From the last week in March onwards throughout April, systematic collecting at sea and investigations in the laboratory have been actively pursued by as many biologists as can be comfortably accommodated During the first half of April ten to twelve investigators occupied seats in the laboratory and about the middle of the month a dozen senior students came in addition The researchers include Prof B Moore (biochemistry), Dr H Roaf (physiology of crustacea), Mr J Pearson (cancer), Mr R D Laurie (biometrics), Mr W J Dakin (Pecten), Prof Herdman, Mr Wollaston, and Mr Gunn, all from Liverpool University, Prof Hickson, Mr Chaffers, and Mr Whitnall, from the Victoria University of Manchester, Mr Unwin from the University of Leeds, and Mr Chadwick, the resident naturalist Plankton collections, both surface and deep, are being taken periodically, at stated localities, over a limited area for statistical purposes, from the S Y *Lady-bird*, and the usual sea-fish hatching and distribution of larval plaice is in progress

Dr B Glanvill Corney, chief medical officer of the Government of Fiji, directs our attention, in a letter received from Fiji, to an instance of poisoning by turtle's flesh which occurred at a village in the island of Vanua Levu, Fiji The turtle was cooked immediately after being killed, and no question of unfitness for food through putrescence arises, indeed, neither the history of its capture and preparation for the oven, nor of the symptoms which supervened after its ingestion, points in any way to poisoning by ptomaines The indications were, on the other hand, that the turtle itself had become poisoned before its capture, presumably through having consumed some unaccustomed article of diet on the reefs That something was wrong with the turtle before it was caught seems certain, as the men who captured it are reported to have discussed the question as to whether it was fit to be eaten Dr A W Campbell, district medical officer and magistrate of the locality near where the poisoning occurred reports the history of the attacks as follows — Severe headache and vomiting, abdominal pain, diarrhœa not marked So far as could be ascertained, in several cases an interval of seventy-two hours intervened between the ingestion of the turtle and the first symptom, and in most cases there was an interval of twenty-four hours Some four or five days after the attacks began, ulceration of the lips, tongue, cheeks, and fauces occurred, and every one of the cases seen was so affected Abdominal pain was not marked in the later stages Twenty-five deaths in all were attributed to poisoning by the turtle's flesh

The fourth part of vol v. of the Annals of the South African Museum contains a paper by Mr S Schenkling on new beetles of the family Cleridæ, and a second, by Mr P Cameron, on parasitic Hymenoptera

A definite mode of measuring the fossæ in the interior of the human skull forms the subject of a paper by Mr A Hrdlička, published as No 1521 of the Proceedings of the U S National Museum Such measurements are of considerable importance in estimating brain-volume, even in cases where the brain itself is available, the weight of that organ tending to alter the shape of its lower surfaces when removed from the skull

We have received copies of several parts of vol xvi of the Transactions of the Academy of Science of St. Louis, published at various dates during 1906 The first of these is devoted to an account of the celebration of the fiftieth anniversary of the first meeting of the academy. Land-snails from Michichan form the subject of a paper by Mr F C Baker, while Mr R J Terry describes the nasal skelton of the salamander *Amblystoma punctatum*, and Mr S Weller discusses the fauna of the Palæozoic Glen Park limestone

In their report for the year ending June, 1906, the trustees of the Australian Museum record their opinion that collections made in New South Wales ought not to be permitted to pass out of the country, especially when, by a simple process of combination amongst the State departments interested the collections in question could be acquired at a reasonable cost and subdivided amongst the various metropolitan and country museums It is also stated that until the museum is enlarged no further progress can be made in the exhibition of specimens to the public

Among the contents of part iii of the third volume of the quarterly issue of Smithsonian Miscellaneous Collections, reference may be made to a paper by Prof Theodore Gill on various non European representatives of the carp family (Cyprinidæ) One of the most remarkable features in the distribution of the group is the total absence of barbels (Barbus), which are so numerous and so widely spread in the Old World, from North America This feature, coupled with the peculiarities of the North American cyprinid fauna generally, is held by the author to afford a strong argument against the inclusion of the northern portions of the three northern continents in a single zoological region It is noteworthy, however, that an approximation to Old World types is met with among the cyprinid fauna of the Pacific slope of North America which is lacking in that of the opposite side of the continent

From a distributional point of view, great interest attaches to the description by Prof Al Mrázek, of Prague, in the *Sitzungsberichte der kgl Böhm Gesellschaft der Wissenschaften* for 1906 of a member of the group of flat-worms known as the Temnocephalidæ, from Montenegro These worms, which are parasitic on fresh-water crayfish and crabs, have hitherto been known only from tropical and subtropical countries, such as Australasia, Malaya, Madagascar, India, Chili, and Brazil, and the occurrence of an outlying form in the Palæarctic area is therefore very remarkable There are, however, other features in the fauna of Montenegro which indicate that it is of a somewhat abnormal type The host of the worm is the crustacean *Atyaëphyra desmaresti*, a species with a rather wide distribution in the south of Europe The locality where the worm was found is the delta of the river Morača, which discharges into the lake of Scutari, and on this ground the name *Scutariella didactyla* is proposed for the new form, which is regarded as generically distinct from Temnocephala. To the same issue Prof.

Meisek contributes an account of a polypharyngeal planarian from Montenegro, this being the second representative of that group from this country

No. 93 of the *Bulletin de l'Institut Océanographique*, published at Monaco, contains an illustrated account, by Mr. E L. Bouvier, of the Paris Museum, of zoological observations made during a cruise in the Atlantic in 1905 on the Prince of Monaco's yacht *Princess Alice* After briefly referring to the cetaceans and pelagic fishes observed, the author devotes considerable space to the invertebrate fauna of the Sargasso Sea, which he declares to be of surpassing interest to the naturalist Among the numerous species figured one of the most striking is a copepod crustacean (*Copilia vitrea*), in which the eyes are unusually large, while the swimming-limbs are richly garnished with feather-like expansions In the latter respect this crustacean presents a curious analogy to the well-known Sargasso fish *Antennarius marmoratus* Other Sargasso invertebrates, like a species of Sagitta, obtain protection by means of the pellucid nature of their tissues Considerable interest attaches to the observation that the hemipterous insects Halobates differ from all other pelagic forms in not seeking shelter below the surface in stormy weather A second chapter is devoted to the deep-sea fauna, among which the author directs special attention to the remarkable holothurian *Pelagothuria bouvieri*

THE *Irish Naturalist* for April contains the report of an address on the problems of an island fauna delivered by Mr. C B Moffat, as president, to the Dublin Naturalists' Field Club on January 8 Starting with the fact that the modern fauna of Ireland is poorer than that of Great Britain, and the latter inferior in richness to that of the Continent, the author raises the question whether the theory that this poverty is due to animals having been unable to effect an entrance into these areas affords a satisfactory solution The idea that oceanic islands have received their faunas by dispersive agencies is held to be untenable, such faunas it is argued, being merely remnants of larger ones derived from ancient continental connections On this hypothesis there would seem to be grounds for the belief that island faunas have an inherent tendency to self-effacement, and it is suggested that this tendency may be in part due to weakness in those members of a species which inhabit the peripheral zone of its distributional area "Both Great Britain and Ireland," it is urged, "certainly have lost, within times that were at least subsequent to the beginning of the ice-age, a considerable number of species, which are shown by the explorers of our caves to have flourished here when we had still a continental connection How they came to die out, we cannot say But I do think it is a mistake to assume that the insulation of the British and Irish areas has affected our fauna and flora in no other way than by preventing the advent of new species We have to explain how we have lost as well as how we have failed to gain "

IN an account, forming vol ii., No 1, of the Philippine Journal of Science, dealing with polypodiaceous ferns collected from one locality, San Ramon, on the Philippine island of Mindanao, Mr E B Copeland discusses their distribution in the different vegetative zones and their structural adaptations The collection amounted to the large number of 184 species, of which one-seventh were local and the rest Malayan In addition to the ecological notes that are very interesting but too detailed for summarising, the author has essayed the difficult task of formulating a taxonomic grouping of the order that is illustrated in a genealogical tree. Lastræa is regarded as a central type from which many branches, *e g* Microlepia, Polystichum, and Goniopteris, have sprung, Polypodium, Athyrium, and Acrophorus are associated with Lastræa as primitive forms

THE third number of the Kew Bulletin for the current year contains a list of flowering plants and cryptogams sent from Labrador by Sir William McGregor Special interest attached to the lichens, as it was suggested that an attempt would be made to naturalise the reindeer if the food material it requires was available in sufficient quantity According to the notes accompanying the specimens, *Cladonia rangiferina* appears to be abundant, and with it are commonly associated *Cetraria aculeata* and *Platysma nivalis* An article, "Alpine Notes from Sikkim," is extracted from a letter written by Mr I H. Burkill describing a tour in search of Aconite tubers, an illustration shows *Aconitum spicatum* and a hybrid Aconite in flower A new genus of Compositæ is defined from Tibetan material by Mr J R Drummond under the name of Chlamydites, having affinities with the Tibetan plant *Cremanthodium Deasyi* Two economic articles provide information on the distillation of camphor and the cultivation of ginseng, a variety of *Aralia quinquefolia*, in Korea.

IN the Journal of the Franklin Institute (vol clxiii, No 3) Prof Oscar C S Carter describes in detail the Government irrigation project at Yuma The project contemplates diversion of the waters of the Colorado River about ten miles north-east of Yuma, Arizona, into two canals In Arizona these canals will irrigate all the bottom lands of the Colorado and Gila rivers between the Laguna dam and the Mexican boundary, an area of 84 000 acres, and in California the bottom lands in the Yuma Indian Reservation an area of 17,000 acres Engineering skill of the highest order will be required The Roosevelt dam in the Salt River Cañon, Arizona, will be solid masonry 285 feet high and, joining the cañon walls several hundred feet apart, will form a lake twenty-five miles long and 200 feet deep The details given tend to show that the United States will soon take the lead as the foremost country where irrigation is practised on a large scale

THE Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol l, part v) contain a suggestive paper on the mechanism of power transmission from electric motors, by Mr Wilfrid I Spence He brings forward possible alternatives to the commoner methods, with typical applications of each system Direct coupled drives are to be preferred to all others whenever practicable Belt drives are to be preferred to any form of strictly positive connection between constant speed motors and fly-wheel operated machinery A fly-wheel is quite useless with a constant speed motor positively connected to its load Single reduction spur gear may be regarded as the standard gear transmission for ratios up to 5 or 6 to 1 When the distance between centres is great, the idler spur gear (cast-iron pinion, raw hide idler, and cast-iron wheel) is a substitute for plain single reduction gear Chain gear may, as a rule, also be used, but only for ratios up to 5 or 6 to 1 For ratios up to 30 to 1, and where space is not of much account, double reduction spur gear is applicable As treble reduction spur gear, which is applicable for reduction between 40 and 150 to 1, takes up much space and is costly, it is not to be recommended When extreme compactness is desirable,

planetary gear drives may be used, and where silent running is desired with total enclosure, and a right-angled transmission is permissible, there is nothing to equal worm gear, which shows to best advantage for reductions of 15 or 20 to 1

We have received from Messrs Wratten and Wainwright specimens of their M screens and "Verichrome" and "Allochrome" plates for photomicrography, together with an explanatory booklet The screens, nine in number consist of gelatin films impregnated with dyes which admit the passage of light of certain wave-lengths, the values of which are given We have examined spectroscopically the light transmitted by each of them, and find it to be correctly stated in the booklet, which also contains a table of the absorption bands of the principal staining agents together with the proper screen and plate that should be used to photograph a specimen stained with any of the stains named The booklet contains a concise statement of the principles involved, of the method of combining the screens directions for tricolour work, exposure, developing &c The plates are undoubtedly some of the best for photomicrography that have yet been placed on the market, and the "Allochrome" plates will be found very useful in ordinary work by those who desire pictures of natural objects showing the proper gradations of light and shade A criticism which might be made is that the gelatin screens are somewhat delicate, being easily affected by damp and heat (it is true they may be obtained cemented between two glass plates, but are then much more costly) We have no hesitation in saying that Messrs Wratten and Wainwright have made a distinct advance, and have brought out their screens and plates on lines far more scientific than has hitherto been done

The London Geological Field Class has arranged its excursions for the study of the London district, under the direction of Prof H G Seeley F R S, to commence on Saturday, April 27 Mr J W Jarvis, St Mark's College Chelsea is the honorary secretary

The Halifax Education and Public Library Committee has arranged for the publication of a series of descriptive pamphlets on the more important objects in the Bankfield Museum under its care We have received a copy of the fourth of the series, sold to the public for one penny, which is on "Egyptian Tablets," and is written by Mr Thomas Midgley, curator of the Bolton Museums The tablets in the Halifax Museum were brought from Thebes to this country by Mr Jeremiah Rawson about 1839 They were built into the wall of one of the rooms of the Halifax Literary and Philosophical Society, and remained practically forgotten until eight years ago, when they were transferred to the Bankfield Museum, walled in, and covered with glass The pamphlet contains the result of Mr Midgley's work in deciphering the tablets The inscriptions all consist of prayers to various gods that funeral offerings of food drink, and so on may be given to the deceased in an after life Mr H Ling Roth, honorary curator of the museum, contributes a preface to the pamphlet

Mr Edward M Langley, of Bedford, writes announcing the discovery of an interesting contribution to the history of English mathematics in the form of a hitherto unpublished letter by the discoverer of "Taylor's theorem" The letter in question was addressed to the Rev Mr Newcome, fellow of St John's College, Cambridge, under date November 24, 1711 In alluding to the appointment of Saunderson to the Lucasian chair of mathematics at Cambridge, Brook Taylor expresses his opinions on the then prevailing spirit of mathematical teaching in the following words, which possess considerable interest in the light of modern thoughts on the subject The writer says —"I am very glad Mr Saunderson has it and hope he will fully answer the expectations the Electors have of him He is an extraordinary Algebraist, and I expect great Improvements in that Art from his hand, but (if I might have my desire) I would rather wish he would apply himself to the cultivation of Pure Geometry That is a large subject worthy of the labours of a Professor, and is abundantly more entertaining than the Contemplation of mere abstract quantities, which are the proper objects of Algebra, but that, truly speaking, is but an introduction to Mathematics as Logic is to Philosophy *And it is my opinion that the prevailing humour of treating Geometry so much in an Algebraical way has prevented many noble discoveries that might otherwise have been made by following the methods of the Ancient Geometricians*"

The report of the Hampstead Scientific Society for the year 1906 shows that the work of the society has continued in a uniformly satisfactory manner The society has been added to the list of "associated societies" of the British Association and is affiliated to the South-Eastern Union of Scientific Societies The Christmas juvenile lectures were successfully repeated, and a nature-study course for the benefit of those teaching young children was conducted by Mr W M Webb

The general report on the operations of the Survey of India during the survey year ending September 30, 1905, has now been published It was during the year with which the report deals that the Government of India appointed a committee to consider, among other matters, the state of the maps in each province and the measures required to bring them up to date This committee has since reported that in many parts of India the maps are so out of date as to be of little use, and in some cases even misleading, owing to changes in roads since they were prepared In order to carry out the recommendations of the committee it will be necessary to revise in the field practically the whole of the existing 1-inch maps of India, and to survey on either the 2-inch or the 1-inch scale the whole of the country for which maps on neither of these scales have ever yet been prepared Omitting the Baluchistan Agency and the tribal area of the North-West Frontier Provinces it is estimated that an area of 525,800 square miles of original survey will have to be re-surveyed, that a practical re-survey will have to be made of 479,000 square miles, while the maps of 266 300 square miles may be capable of revision in the field There remains an area of 266,300 square miles for which cadastral maps are or will be available from which to prepare topographical maps with inconsiderable corrections in the field, and 135,900 square miles, chiefly in Burma, for which the maps are modern, and merely require re-drawing It is proposed that the whole of this work should be carried out within twenty-five years while the survey of Baluchistan, the North West Frontier Province, and the country adjacent thereto should be completed within a much shorter period

The reviewer of the "Zoological Record" in last week's Nature (p 557) regrets to find that in the notice he omitted the second *n* in *Tyrrannosaurus* and *Tyrannosaurus*

OUR ASTRONOMICAL COLUMN

A New Comet (1907*b*).—A telegram from the Kiel Centralstelle announces the discovery of the second comet of the present year by Mr Mellish, at Madison, on April 14. The magnitude of the object is given as 11·0, and its position at 10h 20m (Madison M T) on the day of discovery was R A = 6h 40m, dec = +8° 0′

A second telegram from Kiel states that the comet was observed by Bianchi at Rome on April 16 Its position at 8h 22 1m (Rome M T) was

R A = 7h 0m 17 5s, dec = +17° 19′ 14″

This is about 2½° south of ζ Geminorum, and crosses the meridian at about 5 p m

A New Nebula.—Whilst searching for new double stars on January 18, the Rev T E Espin discovered a nebula in the constellation Perseus which he believes to have been previously unrecorded

This object precedes B D +33° 746 by 7·80s, and is 2′ 25″ south of it, so that it lies somewhere about halfway between ζ and ξ Persei It is about 6″ in diameter, and is elongated towards the north, its brightness being about equal to that of a tenth-magnitude star The later observations appear to suggest a planetary nebula with a small star on the northern edge (Monthly Notices R A S, vol lxvii, No 5, March)

Comet 1905 IV.—A further observation of comet 1905 IV (1906*b*) is recorded in No 4166 (April 5) of the *Astronomische Nachrichten* by Prof E Becker who, with the large refractor of the Strassburg Observatory, saw it as a small round body of about the tenth magnitude on March 4 The observations of this comet now cover a period of about 2½ years

In the same journal Prof Weiss gives a continuation of his ephemeris, extending from April 2 to June 5, which shows that the comet is apparently travelling very slowly through Libra in a north-westerly direction towards Virgo

The Temperature of Mars.—Hitherto the chief obstacle to the belief that Mars is habitable by any such beings as inhabit the earth has been the extremely low temperature probably obtaining on the Martian surface, but in No 25, vol xlii (March), of the Proceedings of the American Academy of Arts and Sciences, Prof Lowell shows that, by taking all the phenomena into consideration, this obstacle may be removed Previous calculations of the temperature have been deduced solely from the relative distance of Mars from the sun, and a recent investigation gave −33° F as the mean temperature of the planet

Prof Lowell points out, however, that other factors, such as the relative albedoes of the planets, the screening effect of clouds, the blanketing effect of the atmosphere, &c should be taken into account, and, on this basis he finds that the mean annual temperature of Mars, if the heat were retained as well there as here, would be about 72° F As the retention is greater in the case of the earth, this value is considerably reduced in the final calculation, taking all the known factors into consideration, and a mean temperature of about 47° F is obtained Prof Lowell also finds that the boiling point of water on Mars would be about 111° F (44° C), that the amount of air per unit surface is about two-ninths that found in the case of the earth whilst the relative density of the air at the surface is only about one-twelfth

Galileo in the Val D'Arno.—The April number of the *Monthly Review* contains an interesting article by Miss Janet Ross giving some details of Galileo's life whilst he dwelt near Florence, first as court mathematician and philosopher, then as a prisoner at the hands of the Inquisition It was at a villa known as "Le Selve," near Signa, that he discovered spots on the sun and wrote his treatise on the planets, his history of sun-spots and other works whilst in a second villa in the neighbourhood, now known as the "Villa dell' Ombrellino," he wrote the "Saggiatore" and commenced his "Dialogues on Motion" After the persecution at Rome in 1633 he lived at Il Gioello Arcetri, and it was here that the Inquisition forbade him to converse with anyone, so that from that date until his death in 1642 he was an isolated prisoner, and for the last four years was totally blind Miss Ross also gives some interesting facts concerning the philosopher's family affairs

Another New Astronomical Journal.—From the Società Astronomica Italiana we have received the first three numbers (January, February, and March) of its monthly bulletin, the *Revista di Astronomia e di Scienze affini* The society was founded by Prof Boccardi, of the Turin Observatory, in November, 1906, and has for its principal aim "the vulgarisation of astronomical conceptions" These bulletins contain original articles astronomical notes, and reviews, together with ephemerides and notes concerning celestial phenomena for the succeeding month, and are published by the society at Turin

The Stonyhurst College Observatory.—Father Sidgreaves's report of the work done at the Stonyhurst Observatory during 1906 contains, in addition to some astronomical notes the detailed results of the magnetic and meteorological observations made during the year On the astronomical side the sun was observed and drawings of the solar surface made on 212 days, and the large grating spectrometer was employed on the larger spots For this work a new heliostat is being built which will carry a 12-inch mirror, and when the instrument is complete it will be possible to employ the full aperture of an 8-inch objective for use with the large Rowland grating in solar spectroscopy Good spectrograms of Mira Ceti and some selected brighter stars were obtained during the year The mean magnetic declination for 1906 was 17° 48′ 3 W

THE TWENTIETH YEAR AT BLUE HILL OBSERVATORY[1]

Blue Hill Observatory on January 30, 1905, completed its twentieth year's work, and it is noteworthy that three out of its staff of four have been there at least eighteen years Owing to the crowds of people brought to the hill by the electric cars, it was found necessary in 1905 to enclose the observatory by wall and fence, some of the secondary instruments having previously been moved for the same reason Blue Hill is one of the few American observatories where the standard instruments have remained in the same position and with unchanged environments for so long a time so that except for the fact that the times of observation were changed to agree with those made by the U S Weather Bureau the records are all strictly comparable Since 1901 the observations have all been published in the metric units, English units being only used in parallel in the summaries

The exploration of the upper air by means of kites carrying instruments which recorded continuously was first originated at Blue Hill in 1894 In 1901 the first observations over the North Atlantic were made by the director, Mr A L Rotch, and Mr Sweetland, using kites flown from a steamer Kite observations are now made whenever possible on the days fixed by the International Committee for Scientific Aeronautics These are generally the first Thursday in each month In 1903 fifteen flights were made nine of these being on days fixed by the committee The average height reached was 2214 metres In 1904, eight out of fourteen flights made were on appointed days and the average height was 2300 metres In 1905, sixteen days were assigned by the International Committee and at Blue Hill flights were made on twelve of these and on four other days, the average height reached was 2120 metres During the three years the maximum height reached was 4468 metres, or 14 662 feet Since 1894, 280 flights have been made at Blue Hill

In September and December, 1904, and January 1905 at the St Louis Exhibition Assman balloons were liberated with instruments During the summer of 1905 another series of ascents was executed by Mr Fergusson Out of the thirty-five balloons liberated at St Louis thirty-two have been returned, most of them with records of pressure and temperature The records show that fifteen balloons

[1] Annals of the Astronomical Observatory of Harvard College Vol lviii, part ii Observations and investigations made at the Blue Hill Meteorological Observatory, Massachusetts, U S A, in the years 1903 and 1904

reached a height of more than 8000 metres (five miles) Two of them had travelled at a rate of 100 miles per hour The maximum height reached was 17,037 metres, or nearly eleven miles, and the lowest temperature recorded was $-79°$ C, at a height of 14,800 metres

While Mr Clayton was crossing the Atlantic to Gibraltar to join M Teisserenc de Bort and M Maurice on the cruise of the *Otaria*, he executed six kite flights, and on the cruise nineteen flights were made From the Azores, Madeira, and Canary and Cape Verde Islands twelve balloons were sent up, and records were obtained of the wind velocity and direction up to altitudes of 13,600 metres It was demonstrated that the upper return trade winds in the northern hemisphere blow generally from the south, and that the chief features of the vertical distribution of temperature and humidity were the differences between the east and west sides of the permanent anticyclone and the stratification of the atmosphere in the region of the trades and the doldrums (see NATURE, November 16, 1905, and March 8, 1906) These investigations are to be continued to see if the proximity of land influences the upper-air currents over the ocean

In the tables giving the records obtained by the flights in 1903 and 1904 at Blue Hill, the reading corresponding with the different altitudes of the kites, are all compared with simultaneous readings made in the observatory, and the initial and final readings on the meteorographs are compared also with those at the station at the base of the hill The height of the kite was determined from its angular height and the length of the wire, with a correction for sag When the kite was not visible, its height was determined from the corrected readings of the barograph it carried

In order to eliminate the effect of sluggishness of the instruments, the temperature readings were taken from the records at points which coincided with stationary points in the flight Humidity was recorded by means of a hair hygrometer, which had been standardised by comparison with a psychrometer before and after the flight The direction of the current in which the kite was flying was determined by the azimuth of the kite from the reel

During 1902 and 1903 a long series of observations was made to study the effect of meteorological conditions on atmospheric refraction From Blue Hill, Boston Lighthouse can be seen more than fourteen miles away, and the difference between the geodetic and observed dip of the line of sight observed three times a day W M

SCIENTIFIC WORK IN THE STRAITS SETTLEMENTS AND CEYLON

THE last number of the Journal of the Straits Branch of the Royal Asiatic Society is full of matter interesting to various classes of readers —for botanists, Mr H N Ridley's studies on the grasses, sedges, Scitamineæ, and Begonias of Borneo, for zoologists, Mr P Cameron's account of the Hymenoptera of Sarawak, for anthropologists, Mrs Bland's description of the curious Anyam Gila basketry of Malacca, and Mr Howell's Dyak ceremonies in pregnancy and childbirth, with a list of remarkable taboos imposed upon the woman before and after delivery, and, lastly, for folklorists several tales collected by Messrs Maxwell and Laidlaw The most important contribution to the number is Mr Ridley's article on the menagerie at the Botanic Gardens, Singapore This was started by a local society in 1859 taken over by the Government in 1874, and, finally, the valuable collection was dispersed in 1903 on the ground that the authorities could not afford funds for buildings and a modest annual grant for maintenance It is certainly a misfortune that this institution should have met such a fate As Mr Ridley points out, there are few places in the world better suited for a zoological garden than Singapore Maintenance charges are low, and the vicinity of the source of supply renders it possible to procure specimens at a small cost Mr Ridley gives valuable notes on the various genera, and supplies useful hints on the methods of keeping animals in captivity He lays down as a maxim that "the only way of knowing what an animal thinks is comfortable and snug is to keep it and observe its ways. It will soon let you know what it likes, which probably does not at all fall in with your ideas of what it ought to like" His notes on the habits of the larger Quadrumana are based on first-hand knowledge. A pair of Indian jackals, he tells us, bred in the gardens, which is, to say the least, unusual The Malay tapir (*Tapirus indicus*) displayed remarkable cryptic characters When in its young pelage it hid in a palm bush, "and when I went to fetch it, on opening the bush and looking down, I could not see it. I seemed to be looking on the dark brown ground with spots of sunlight through the leaves The little animal lay in such a position that the yellow spots were exactly where the vertical sun rays would fall, the yellow streaks resembling the slanting streaks of light from the side It was for a few minutes quite invisible, though I was looking down on it" No 47 of the journal of the same branch of the society is devoted completely to a Malay manuscript entitled "Hikaiat Shamsu'l Bahrain," which, however, has no claims to special interest, being of a common type

The address delivered by the Hon J Ferguson, president of the Ceylon branch of the Royal Asiatic Society, gives an interesting sketch of past and present scientific work in the island In natural science the most valuable recent publication is that of Prof Herdman, on the pearl oyster fisheries, with supplementary reports on the marine biology by other naturalists The mineralogical survey has led to the discovery of many novelties, including thorianite, the only thorium-bearing substance to be found in any British possession It is much to be regretted that the local government has been unable to provide funds for the establishment of an observatory, the want of which is much felt by the shipping trade, and was obliged to decline the offer of Mr A R Brown, one of the Cambridge school of anthropologists, to undertake a survey of the Veddas The suggestion made by Sir H. A Blake, on native authority, that the connection between mosquitoes and malaria was known to Susruta, a Hindu writer of the fourth century A D, has been examined by Prof Jolly, with the result that the term Masaka cannot be confined to the mosquito, but includes various other insects popularly believed to cause disease In regard to membership, the society is in a sound position In spite, however, of the president's optimism, we gather that the supply of papers is not so large as might be desired, and that some of the enthusiasm which has revived the sister society at Calcutta is needed at Colombo.

AGRICULTURAL EXPERIMENTS

WISCONSIN Experiment Station Twenty-second Annual Report—From the time of Thomas Andrew Knight onwards, horticulturists have remarked the effects of an excessive food supply on variability in cultivated plants; but one seldom hears of a case in which such pronounced results have followed excessive feeding as those which occurred in an experiment described by Mr E P Sandsten in the twenty-second annual report of the Agricultural Experiment Station of the University of Wisconsin. To a batch of tomato seedlings growing in a greenhouse a mixed manure consisting of 800 lb nitrate of soda, 600 lb sulphate of potash, and 1000 lb bone per acre was applied The seedlings soon began to vary, with the result that out of ninety-six plants scarcely any two were alike Some plants were dwarfed, others developed internodes of abnormal length, the leaves varied in size and shape; the blossoms were abnormal in form, the stamens were much modified, and in one case became "almost aborted," the pistils, on the other hand, were greatly overgrown, and some of the plants produced seedless fruits Two seedless types, a large- and small-fruited, were specially noticeable, and cuttings of those and of some of the other marked variations were made These were subsequently grown in an ordinary soil, and produced plants which retained all their abnormal characters

Variation in the Composition of Milk.—In Bulletin No 11 of the Edinburgh and East of Scotland Agricultural College, Dr Alex Lauder gives some interesting par-

details about the composition of the milk of a well-managed and well-fed herd of Shorthorn dairy cows. The herd, numbering twenty-two, was maintained for the purpose of supplying Rosslynlee Asylum with milk. The milk of each cow was weighed daily, and sampled weekly, the mixed milk of the herd was also sampled once a week. The investigation began in May, 1905, and lasted for a year. The cows were milked at 6.30 a.m. and at 4 p.m., and, as is always the case when the milking periods are unequal, the milk was found to be poorer after the longer than after the shorter interval. The morning milk averaged 3.15 per cent. of fat for the whole year, while the evening milk averaged 3.91 per cent. There was a marked difference in the milk of individual cows, one animal, for example, produced 635 gallons of milk during the year, containing 3.58 per cent. fat in the morning and 4.81 per cent. fat in the evening, while another produced 638 gallons, which contained only 2.96 per cent. fat in the morning and 3.5 per cent. fat in the evening. Until the middle of January the mixed milk of the herd always contained more than 3 per cent. of fat, but in spite of good management the quality then began to fall, and during the next three months the mixed milk contained less than 3 per cent. of fat eight times in the morning and four times in the evening, as the milk was sampled only once a week it must, therefore, have usually contained less than 3 per cent. of fat in the mornings in February, March, and April. Although the cows were liberally fed additional rations were tried for the purpose of improving the quality of the milk and four animals were given 2 lb. linseed cake and 2 lb. oats per head per day. In accordance with experience, it was found that the addition of concentrated foods to rations already liberal produced no improvement in the milk.

West of Scotland Agricultural College Reports on Experiments, 1906.—The seventh and eighth annual reports of the West of Scotland Agricultural College have been issued as a single volume. This volume contains reprints of four bulletins which have already been issued separately. Among the subjects dealt with are the uses of inoculating materials for leguminous crops. Several crops were treated, but the only positive results were obtained with lucerne. At two centres it was found that lucerne was much benefited by treatment with Hiltner's inoculating material. In the first case lucerne was sown on April 12 on land which had probably never grown this crop, and had certainly not done so for twenty-eight years. Part of the seed was treated and part untreated. Early in July the crop growing from treated seed began to show signs of improvement, and in August, when flowering, it stood 20 inches to 21 inches high, while the adjacent untreated crop was but 13 inches to 14 inches. It was noticed that the inoculating material only did good on land which was well supplied with phosphates and potash; on soil deficient in either of these inoculation produced no effect. At the second centre lucerne had been growing for a year before it was treated, and it was noticed that a few nodules had developed on the roots, but the crop was far from vigorous. On May 28 some sand was inoculated, and this was sprinkled over part of the lucerne. On July 15 the lucerne was cut, the treated plot then yielded 56 cwt. and the untreated plot 54 cwt. per acre, so that inoculation had not been effective. Directly after mowing however an improvement in the treated crop was noticed, and this improvement became more marked as time went on, so that when a second cutting was made on September 25 the land which had been treated with Hiltner's culture produced 74 cwt. per acre, as against 30 cwt. from the untreated soil. These experiments were made in 1905, when, at the instance of the Board of Agriculture, similar experiments were made in all parts of the country, and the West of Scotland tests illustrate the general result, which was that inoculating material proved useful for a leguminous crop newly introduced into a district, but was seldom beneficial in the case of crops commonly cultivated. The nodule organisms of these are abundant in most soils. Several of the experiments recorded in this volume deal with the best time of year at which to apply manures. In the case of turnips, the conclusion is stated that superphosphate, basic slag, kainit, and muriate of potash are better applied in spring than in autumn, for hay, on the other hand, it is better to apply potash manures in autumn than in spring. For both turnips and potatoes it was found to be more profitable to apply farmyard manure in spring than in autumn.

ANTIPODEAN BIRD-LIFE.[1]

In an illustrated pamphlet bearing the date 1903, and published at the Government Press, Wellington, Mr. R. Henry, who has for many years acted as caretaker of the bird-reserve on Resolution Island, furnishes a fund of interesting information with regard to the habits and life-history of the flightless birds of New Zealand, with notes relating to other species. As he himself remarks, if anybody ought to know what there is to be known about New Zealand birds it is the author, who has, *willy-nilly*, enjoyed exceptional opportunities of observing them. As might have been surmised, a large amount of space is devoted to the birds commonly known in this country as kiwis (Apteryx). It appears, however, according to the author that this usage is not justified, the name kiwi belonging by right only to the grey species and its immediate relatives, while such species as *A. australis* and *A. oweni* are designated "roa" by the Maori. Very interesting are the author's observations with regard to the breeding habits of these birds, among which the cock assumes the office of incubation. As regards kiwis, it is stated that although they live in nearly the same situations as rowas they prefer open ground, while the latter seek the densest shade of the forest. "Kiwis generally have white grubs in their stomachs, with things like big maggots, wire worms, and all that class, while the roas depend more upon earthworms, water-insects, and berries." When a roa becomes conscious of the presence of intruders it alters its usual stealthy gait to a loud tramp. Is this, it may be asked, defiance?

A very strange statement is made about the kakapo, or ground-parrot, namely, that it breeds only once in two years. This, however, is not all, for it is stated that in place of some individuals nesting in one year and others in the succeeding season the whole of the birds will breed in one particular year, while in the following year none will do so.

Continuing his remarks on the habits of the kakapo, the author observes that, "months before the appointed breeding season the male is developing an air sac in his throat which he can puff up like a drum, and which may act like a sounding-board to assist in making the curious drumming notes in the spring. This note is not unlike the boom of the bittern, but is repeated five or six times in succession, and can be heard at a great distance. It appears as if the breeding season were controlled by the males, for when there is no drumming in the early summer, there are no eggs or young ones."

Another bird about which the author has a good deal to say is the weka rail, or wood-hen, and it cannot be said that he gives it a good character, mainly on account of its egg-stealing habits. One of these birds, although it had never previously seen a goose in its life, seemed to know by instinct that the eggs of the latter would be buried in the ground, and promptly proceeded to disinter them. Apart from moas and the nearly extinct Notornis penguins are the last of the flightless birds to claim the attention of the author. He has, however, much to say regarding such species as black swans, paradise-ducks, grebes, moreporks, &c., and in the case of all these the ornithologist should find much to interest him in this little volume, which is certainly a storehouse of information with regard to the habits of New Zealand's birds. It may be hoped that the Government will not only see its way to maintain Resolution Island as a bird-sanctuary, but that it may establish other stations of the same nature.

1 "The Habits of the Flightless Birds of New Zealand; with Notes on other New Zealand Birds." By R. Henry. Pp. 88; illustrated. (Wellington, 1903.)
"Glimpses of Australian Bird Life." Thirty-one original photographs direct from Nature, with Notes by R. Hall. Pp. 63. (Melbourne: T. C. Lothian, 1906.) Price 1s.

"Glimpses of Australian Bird-life" is a praiseworthy attempt to encourage the study of the avifauna of the island-continent among field naturalists. The photographs, although on a small scale, are for the most part excellent, while Mr. Robert Hall's brief explanatory notes are (as might be expected) very much to the point. One of the most interesting species depicted is the whip-bird (or coachwhip-bird), while from the point of view of excellence in technique special mention may be made of the portrait of the so-called reed-warbler and its nest. R. L.

NOTES ON RECENT PETROGRAPHY

STUDENTS of the processes of sedimentation and of flocculation in clays should not overlook the three papers on sands and sediments, by Messrs. Mellard Reade and Philip Holland, that have been published in the Proceedings of the Liverpool Geological Society. The original analyses of sediments given in the second paper (vol. x., part i., 1905), and in the third now issued (1906), are distinctly valuable. Some of the specific gravities stated for clays seem a little high, but it must be admitted that we possess as yet far too little knowledge of our commonest sedimentary deposits. In vol. x., part ii. (1906), p. 136, the authors point out that "the experiments have, we think, demonstrated the existence of a mass of matter of unsuspected granular minuteness distributed throughout the sedimentary rocks of the earth.

We have strong grounds for thinking that the distribution of the finest sediment, in the form of what we may call quartz-dust, is oceanic." The abundance of quartz grains in some rocks popularly classed as argillaceous, such as "slates of coarse texture" (p. 156), is of course already familiar to agricultural investigators.

Mr. H. W. Nichols, in describing new forms of concretions (Field Columbian Museum Publications, Geological Series, vol. iii., No. 3, 1906), usefully brings to the front Forchammer's determinations of magnesia in the skeletons or shells of marine organisms, which were originally published in 1849. Mr. Nichols supports these by analyses of his own (pp. 48–9), *Corallium rubrum* giving him 0.32 per cent. of magnesium carbonate. Forchammer's Mediterranean Serpula yielded as high a figure as 7.64 per cent. The Zoantharia examined give only from 0.35 per cent. to 0.54 per cent.

Messrs. Allen, Wright, and Clement have experimentally investigated the minerals of the composition $MgSiO_3$ (*American Journal of Science*, vol. xxii., November, 1906), and have produced artificially the two pyroxenic types, monoclinic and rhombic, and the corresponding two amphibolic types. At atmospheric pressure (p. 415), the monoclinic pyroxene, $MgSiO_3$, a rare form in nature, is found to be the product of crystallisation from solvents; the material used for this experiment may be any of the forms of crystalline $MgSiO_3$. All the other forms of magnesium silicate (p. 437) pass into the monoclinic pyroxenic form at temperatures between 1150° and 1300°, depending on the crystal-form employed. Enstatite crystallises at lower temperatures than the monoclinic pyroxene. The amphibolic types have been produced by a rapid cooling, which, as the authors point out, is not likely to be the prevailing cause of their occurrence in natural rocks.

Mr. H. I. Jensen, in dealing with the volcanic area of the East Moreton and Wide Bay districts, Queensland (Proc. Linnean Soc. of New South Wales, 1906, p. 73), describes a number of trachytes containing riebeckite, some of which form important plugs or domes. Trachytes, as well as basalts, are recorded from Gough Island, in the South Atlantic, by Messrs. Pirie and R. Campbell (Proc. Royal Physical Soc. of Edinburgh, vol. xvi., 1906, p. 258). Mr. I. G. Sundell (*Bull. Comm. géol. de Finlande*, No. 16, 1905), writing in English, or American, affirms the importance of cancrinite as "a very abundant and doubtless primary constituent" of the syenites of the parish of Kuolajärvi in N. Finland. His paper, like many others from various parts of the world, shows the strong influence already exerted by the Chicago system of classifying igneous rocks.

Mr. G. K. Gilbert (Bull. Geol. Soc. America, vol. xvii., 1906, p. 321) discusses gravitational assemblage in granite, citing striking cases from the Sierra Nevada, where large crystals of felspar and hornblende have respectively assembled in aggregates in granite. An example of banded granite, where bands rich in hornblende and mica alternate with others rich in felspar and quartz, suggests to the author successive sedimentation. Unconformities occur in the banding (p. 324), a dark band always forming the base of the upper series, and truncating obliquely the edges of previous bands. Mr. Gilbert puts forward the view, as a hypothesis, that a pair of bands represents a unit of deposition from the original magma, gravitation playing a *rôle* in the process.

Mr. R. A. Daly, of Ottawa, whose work in the field of igneous absorption and intermingling is well known, states his case of the Moyie Sill in the Purcell Range with effective lucidity in the *Festschrift zum siebzigsten Geburtstage von Harry Rosenbusch* (Stuttgart, Schweizerbart'sche Verlagsbuchhandlung, 1906). His contribution is entitled "The Differentiation of a Secondary Magma through Gravitative Adjustment," and his argument for the assimilation of a felspathic quartzite-series by a gabbro-magma is supported by a number of chemical analyses. A granite zone intervenes between the gabbro and the overlying part of the quartzite-series, and the author holds that (p. 225) "there is clear chemical proof that the greater proportion of the elements in the granite could have been derived directly by fusion of the quartzite." The gabbro, in its onward passage, absorbed beds of quartzite, but (p. 228) "simultaneously gravitative adjustment has nearly restored the original composition, as the acid, assimilated material rose through the denser gabbro magma to the top of the sill." We need not subscribe as yet to Mr. Daly's view (p. 233 and previous papers) that the pure igneous magma in the earth's crust is of basic composition, since there may be a variety of pure magmas in a variety of localities, yet we believe that there is much soundness in his concluding sentence:—"The fact of 'consanguinity' among the igneous rocks of a petrographical province may be due as much to assimilation as to differentiation." G. A. J. C.

ARCHÆOLOGY IN ITALY

THE final rejection by the Italian Government of Prof. Waldstein's well-advertised project for an international excavation of Herculaneum gives the Rome correspondent of the *Times* food for reflection with regard to the alleged Chauvinism of Italian archæologists, who will allow no foreigner to take part in Italian excavations, notwithstanding the fact, which they admit freely enough, that Græco-Roman antiquity is the property of the whole world, and not of Italy alone. While admitting that the postponement of the excavation of Herculaneum until such time as Italy can do it by herself does not much matter from the scientific standpoint, since "the treasures which lie beneath Resina are in safe keeping, and might remain undisturbed for centuries," the correspondent remarks that this is by no means the case with regard to other sites, which cry aloud for speedy excavation for valuable evidence is in their case being destroyed daily by the "march of modern improvement." To do the work, Italy can muster neither sufficient money nor sufficient men, especially the latter. Yet she will not invite foreign aid which would willingly and gratefully be given by archæological students all over the world. As the *Times* correspondent is obliged regretfully to admit, "The foreigner is at liberty to pay his *lira* for admission to museums and other places; he may even give a round sum for the completion of some work in which he is interested, as long as he does not wish to help in carrying it out himself; he may turn his talents to such use as advertising the achievements of Italian archæologists or translating their books into another language; he may show an intelligent and devoted interest, but it must be from a discreet distance. That, at least, seems to be the moral of all the recent relations between Italy and other countries in the archæological questions which have come to the front during the last twenty years or so. One would willingly believe it otherwise; one would gladly put a more literal and liberal interpretation on their professions of confraternity; but how is it possible

to do so unless Italian archæologists support their words by actual deeds? One simple fact outweighs all their written and spoken utterances Nowhere in Italy is any foreign enterprise at work, and never has any foreigner been invited to give his time and his talents to what is, in their own admission, a common cause If Italian archæologists would pay to other nations the graceful compliment of employing, now and then, their students as assistants, if those derelict excavations on the shore of the Gulf of Taranto—whose need is so pressing and whose secrets are so necessary to history—could be, even temporarily, confided to foreign institutions, then, and not till then, their assurances would carry weight '

PROGRESSIVE WAVES IN RIVERS [1]

THE stationary waves produced by the interaction of a rapid stream with its bed have been the subject of several investigations The author finds that by a special mode of vision described in the paper the simultaneous presence of waves progressing down stream can be readily detected

In a very shallow stream with a steep channel the progressive wave becomes the principal and obvious, instead of a subordinate and obscure, feature In this case the velocity of flow is much reduced by friction The slightest excess of retardation at any point momentarily increases the depth there, and increase in depth (where the depths are small) increases the velocity, at any rate in the upper layer Continuous motion is therefore impossible and is replaced by a gushing flow If the bed be of nearly uniform cross-section, the gushes take the form of regular transverse progressive waves If, on the other hand, the cross section of the channel be very uneven, there may be no lateral coordination, and the intermittence of flow is only detected by the rushing sound and the beating action of the water against an immersed body

Measurements showed that the total velocity of these roll-waves was equal to the velocity of the current *plus* the velocity of a long wave in water of the observed depth

All waterfalls tend to break up into conical masses called water rockets, and in rare cases a fall may be seen which consists of a slow procession of well separated "rockets" ranged in roughly horizontal lines A case is described in which this beautiful appearance was due to the formation of roll-waves above the fall

Roll-waves spontaneously arising in very shallow conduits occur in groups, and the growth of amplitude and wave-length was measured in the case of the conduit of the Grünnbach at Merligen, on the Lake of Thun

Roll-waves in shallow mountain rivers due to heavy rains in the gathering ground of the tributary streams are solitary, and, coming without warning before the turbid waters arrive, are dangerous to anglers who are familiar with the phenomenon on the Tees Ure Swale and other rivers The uniform cross-section of the Tees near Barnard Castle and of the Ure near Aysgarth, is peculiarly favourable to their formation and growth

The cross-stream progressive waves observed by the author in the Whirlpool Rapids of Niagara are a secondary phenomenon arising from the varying amplitude of the familiar stationary waves, a variation which the author traces to its cause When their interference occurs at the intersecting crest of two stationary waves there ensues one of those great leaps of water which present so splendid an appearance in these rapids The author invites special attention to the points in which his explanation of these phenomena in Niagara Rapids differs from those hitherto current

Tidal bores are the only form of progressive wave in rivers which had hitherto received much scientific attention. The author deals with the question of what determines the place of origin of the tidal bore in the River Severn, and what is the cause of its apparently capricious variation in magnitude Briefly, the bore originates where the slope of the channel is steep but in the *upper*, not the lower, part of the steep slope because there is in the upper part no alternative channel among the sand-banks for the last-of-ebb and first-of-flood respectively to pursue, but at the end of a set of spring tides the flood has so far cut in the sand an alternative, straight channel that the height of the bore is reduced An excess of land-water, on the contrary, so strengthens the ebb that it tends to make a deep, solitary curved channel up which the flood must force its way increasing the height of the bore

[1] Abstract of a paper by Dr Vaughan Cornish in the *Geographical Journal* for January

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE Western University of Pennsylvania has conferred the honorary degree of LL D upon Sir Robert Ball, Sir Robert Cranston Sir William Turner, Sir William Preece, Mr Marconi Dr Chalmers Mitchell, Dr John Rhys, the Rev E S Roberts (Master of Caius College, Cambridge), and Mr Edwin Abbey

A CONFERENCE on the teaching of hygiene and temperance in the universities and schools of the British Empire will be held at the Examination Hall Victoria Embankment, on St George's Day April 23 The chairman at the morning session will be Lord Strathcona and at the afternoon session Sir John Gorst

THE annual exhibition of students' work will be held at the Borough Polytechnic Institute on Saturday April 20 from 6–9 30 p m The workshops laboratories, drawing offices girls' trade school domestic economy rooms and other departments of the institute will be open for inspection, and practical work will be carried on during the evening

THE *Times* correspondent at Ottawa reports that the medical building of McGill University Montreal was destroyed by fire on April 16 The museum, with its priceless specimens, is ruined, but a portion of the valuable medical library was saved The loss is placed at 100 000*l*, of which 70 000*l* is covered by insurance The origin of the fire is unknown but incendiarism is suspected

THE accommodation provided at University of London University College for the schools of engineering and of architecture will be considerably extended before the beginning of the next session in October by the additional space which becomes available through the removal of University College School to Hampstead The Andrews scholarships are offered for competition in May one of these scholarships value 30*l* in science and mathematics, is tenable in the school of engineering

A PARTY of students of zoology from the Birkbeck College spent part of their Easter vacation in Jersey shore-collecting during the prevailing low tides More than one hundred and fifty species of shore-life were obtained, illustrating nearly all the animal phyla The success of the visit was in great part due to the advice and guidance of Mr J Sinel, formerly director of the Jersey Marine Biological Station A selection from the species collected formed a very interesting exhibit at the annual exhibition meeting of the Birkbeck Natural History Society, which was held on Saturday evening April 13

THE reports from the universities and colleges which participated, during the year ended March 31 1906, in the annual grant of 100 000*l* made by Parliament for "university colleges in Great Britain," and from the three colleges in Wales which receive a grant of 4000*l* each, have now been published (Cd 3409) by the Board of Education Much instructive information can be gathered from the income and expenditure accounts provided by the various institutions With an income of 42 819*l*, Birmingham University at the end of the year's working had a balance in its favour of 2557*l* Leeds University though it started the year with 1568*l* in hand after expending 45 744*l* ended the year with 395*l* only to the good With an expenditure of 53,162*l* Liverpool had 532*l* in hand at the end of the year Manchester with an income of 59 155*l*, came to the close of the year with 131*l* to the good Sheffield, which in the year under consideration was still a university college was with an income of nearly 25,000*l* about 1500*l* in debt at the end

of the year Bristol with a much smaller income, did not spend it all Dundee just about made both ends meet Bedford College, London, had a small deficit King's College, London, with an income of 33,282*l*, managed to save 618*l* University College, London, spent rather more than its income. The college at Newcastle had a deficit Nottingham had been adopting a saving policy with a view to future developments, and arrived at the end of the year with a good balance Reading spent more than it received, and Southampton was in want of money Though the conditions have been modified to some extent since the year with which the report deals there is still the same careful and economical management required at all these colleges, and desirable improvements and developments have to be postponed for lack of funds We hope it will not be long before the Government is able to provide more than 100,000*l* for higher education, and that increased State aid will be supplemented by greater munificence on the part of our men of wealth

A NEW era in the chemical department of the Scottish universities has been inaugurated by the erection of a chemical research laboratory at St Andrews University by the munificence of Prof. Thomas Purdie, F R S at a cost of about 9000*l* Moreover, the 5000*l* originally set aside by the University Court from the Carnegie trust

The Purdie Chemical Research Laboratory, University of St Andrews

quinquennial grant for buildings, &c, to aid in this work has by a subsequent arrangement of the Court and the Carnegie trust, been constituted an endowment for the upkeep of the chemical research department A teaching chemical laboratory had previously been presented to the University by the generosity of Mrs Thomas Purdie late of Castlecliffe The former occupants of the chair, viz Profs Connel and Heddle, were distinguished in their way, viz, the former in regard to the dew point and other subjects, and the latter in mineralogy and the chemistry of minerals, but chemical research proper dates from Prof Purdie's appointment in 1884 and has now been firmly established in the University The substantial new building, which is seen in elevation in the accompanying illustration, provides still further facilities for post-graduate work On the ground floor is a graduates' research laboratory with ten benches, each with high- and low-pressure water-taps, electric light and power, and there are also balance, operation physical and dark rooms Ventilation, light and heat are perfect, so that the workers are under the best possible conditions On the second floor is the professor's laboratory for four workers, a library, museum, spacious lecture-room, and various preparation rooms The progress of the University as a chemical research school has been rapid, for previous to 1884 the accommodation was altogether inadequate. Now the facilities for teaching and research are not behind those of any of the modern German institutions Moreover not only St Andrews students, but other capable workers are welcomed Working in conjunction with the professor or lecturer on organic chemistry, students qualify for various scholarships, e g the Berry, Carnegie, and 1851 Exhibition scholarship, the research degree of London University, and the D Sc degree The school has especially been noted for its work in optical activity and the chemistry of the sugars, but other subjects of biological interest have also been dealt with

SOCIETIES AND ACADEMIES

London

Royal Society December 6, 1906 —"The Chemistry of Globulin" By William **Sutherland.** Communicated by Dr C J Martin, F R S

The author's object in the present paper is first to establish simple formulæ for the more important of the experimental results obtained by Hardy and Mellanby, then to interpret these in their bearing upon the chemistry of globulin in connection with a theory of colloids, and finally to find the molecular mass (weight) of globulin

By expressing the experimental results of Hardy and Mellanby in simple formulæ, it is shown that the solution of globulin and its precipitation take place under simple conditions of chemical equilibrium For example, if p is the fraction of a globulin suspension dissolved in a salt solution the concentration of which is the fraction q of C that is required just to dissolve the whole of the suspension, we get equation (1) $p(1-q)=Aq(1-p)$, in which A is the ratio of a velocity of solution to a velocity of precipitation Mellanby's discovery of the dependence of M/C on valency and ionic velocity is applied to MA/C, M being molecular mass, and it is shown that when temperature varies, not only does MA/C depend upon the viscosity of the solvent water, but also on a function of temperature given in an equation which expresses the part played by globulin It is noteworthy that this function has a minimum value about 40° C, near the temperature of warm-blooded animals

For the precipitation of globulin by excess of $(NH_4)_2SO_4$ an equation is established, namely, $p(1+p)=28\ 8(c-0\ 152)$, p being the fraction which the precipitated globulin is of the whole, and c the concentration of the $(NH_4)_2SO_4$ solution in grams per cubic centimetre

Then follow formulæ for the remarkable precipitation of globulin by acids from solution in neutral salts. From these it appears that three compounds of globulin react in producing this precipitate

Section iv is devoted to a theory of the colloidal state, namely that a colloid consists of molecules which are chemically united neighbour to neighbour by the action of valencies which are usually latent.

According to this chemical theory of the colloidal state, the term molecule ceases to have a useful meaning when applied to a colloid, so the term semplar is used to name that structure which is repeated like a pattern in three dimensions through a colloid By suppression of the colloid producing valencies of doublets a mass of semplars is caused to fall into a collection of separate molecules. In illustration of the usefulness of this theory, it is applied to show the dependence of the coagulating power of an ion on its valence It is then applied also to explain the remarkable fact that the amount of globulin dissolved by

a given salt solution from a globulin suspension depends on the concentration of the suspension The action of the ions of a neutral salt in dissolving globulin is treated as only another manifestation of the same electrical effect which enables them to coagulate arsenious sulphide This theory of the colloidal state leads to a theory of equation (1) and of the laws of A in it, especially that MA/C is proportional to the sum of the squares of the valencies of the ions of the electrolyte

In Section v the experiments of Hardy on the conductivities of globulin solutions are expressed by formulæ which admit of very simple interpretation, and connect these conductivities with those of ordinary electrolytes

In Section vi globulin is shown to have probably a molecular mass 40,000 and a basicity 2, the alternative being a mass 60,000 and basicity 3 Further experiments like those of Hardy on the ionic velocity of globulin and also on the coefficient of diffusion of globulin solutions would decide the matter, though doubtless various globulins differ in mass and basicity A group, $C_{12}H_{20}N_3O_4$, related to polypeptides and peptones, is shown to be the predominant structure in albumins The discrepant results of different experimenters on the precipitation of albumin by heavy metals fall into harmony when it is proved that they precipitated different integral numbers of a group such as this in combination with an equivalent of heavy metal

February 7—"Experiments made to determine the Conditions under which 'Specific' Bacteria derived from Sewage may be Present in the Air of Ventilating Pipes Drains, Inspection Chambers, and Sewers" By Major W H **Horrocks** Communicated by Colonel D Bruce, C B, F R S

Most sanitarians at the present time believe that when sewage is in a state of putrefaction and gas bubbles rising through it, are bursting at the surface, bacteria may be ejected into the air of sewers It is also considered possible that when sewage has dried on the surfaces of pipes bacteria may be separated as dried particles and carried some distance by currents of air passing through the pipes But it is not generally credited that the mere passage of infected sewage through a well-laid drainage system will also cause the ejection of specific bacteria into the air contained in the pipes The experiments detailed show that —

(1) The bursting of bubbles at the surface of sewage under artificial and natural conditions may cause the ejection of bacteria, which, if air currents are present, may be carried some distance

(2) Specific bacteria dried on the ventilating pipes of a drainage system may be separated and carried by currents of air passing through the system

(3) Specific bacteria may be ejected from *fresh* sewage flowing through a sewer under natural conditions independently of the creation of bubbles and the separation of dried particles The ejection of bacteria occurs, not only when use is made of naked microbes such as are obtained from growths on agar but also when typhoid stools are employed as the infecting agent

The results obtained, especially as regards the ejection of bacteria from fresh sewage are of great importance, and indicate that the disconnection of a house-drainage system from a public sewer is sound in principle, and that it would not be wise to remove the disconnecting trap and ventilate sewers by means of house-ventilating pipes or soil pipes

Royal Microscopical Society, March 20 —Dr J W H Eyre vice-president, in the chair —Some South African Tardigrada J **Murray** The author was indebted for the materials for his paper to Mr W Milne, of Uitenhage, Cape Colony, who, from time to time in 1906, forwarded moss containing bdelloid rotifers from various parts of Cape Colony In addition to the rotifers, which were abundant, the moss yielded many Tardigrada Fourteen species were found belonging to the genera Echiniscus Milnesium, and Macrobiotus Eight out of the fourteen species are distinct from any previously known —Notes on a peculiar habitat of a Chlorophyte, *Myxonema tenue* A D. **Hardy** The *Myxonema tenue* is usually found in rapidly flowing water frequently attached to submerged parts of river-side plants, but more often to stones and dead twigs, it is also found in the locality in stone-paved gutters in which there is a rapid flow of water The author also found it growing feebly in a small fish pond, about 10 feet diameter, where the water was nearly stagnant, but on some gold fish in the pond it grew luxuriantly, and the author thinks that some interest attaches to the adaptation of this stream loving Myxonema, which unable to thrive in stagnant water, yet flourished on moving objects where it obtained necessary water friction It may be added that the effect of this algal growth on the fishes was their premature death

Mathematical Society, April 11 – Sir W D Niven, vice president in the chair – An introduction to the metrical geometry of space of *n* dimensions H **Bateman**. —A note on Perott s theorem H **Hilton** —Poisson's integral and its relation to the proof of Fourier's theorem Dr F W **Hobson** —The values of the parameters for which a definite integral can be zero H **Bateman**.

PARIS

Academy of Sciences, April 8 —M A Chauveau in the chair —The photography of the infra-red solar spectrum G **Millochau** By the use of alcoholic solutions of malachite green full details of the exact method being given the author has been able to prepare plates of high sensibility in the infra-red region By the use of these plates photographs have been taken of the region 0·750 μ to 0·950 μ one Ångstrom unit having a length of about 0·1 mm These plates show that the band A has the same structure as the band B The line Z previously described as a short band in the infra red, has now been resolved into lines — The surface engendered by a circular helix Eugène **Barré** —A problem of analysis intimately connected with the problem of cooling of a heterogeneous bar W **Stekloff** —Orthogonal systems of functions and the equation of Fredholm Frédéric **Riesz** - The altitude of the Grand Pic de la Meije Paul **Helbronner** The mean result of the measurements is 3982·5 metres (summit of the signal) differing only by 4 metres from the earlier result of Durand —The action of a magnetic field on ionised air in motion, A **Blanc** On the hypothesis that the mobilities of the ions are not modified by the magnetic field, an assumption shown to be accurate by direct experiment, it is found that the negative ions have a greater mobility than the positive ions, the ratios obtained varying between 1 and 1·6, the average of fourteen experiments giving 1·32 - The oscillations of a higher order (harmonics) in the electric spark G A **Hemsalech** The existence of harmonics in the electric spark is clearly demonstrated experimentally by photographic means, an enlarged reproduction of one of the photographs being shown It was found that the harmonics are in great part the cause of the luminosity of the metallic vapour in the spark -The constitution of the atom and the law of Colomb H **Pellat** It was shown in a previous paper that to bring the current theory of the atom into harmony with experimental results either the atom must have a form approximating to a flattened disc or Colomb s law ceases to be applicable at intra-atomic distances In the present communication it is proved that a flattened form of the atom would not be stable and consequently Colomb's law must cease to be exact at the very small distances of the order of intra atomic distances the attracting force must increase less rapidly than the inverse of the square of the distance or the repulsive force more rapidly —Some observations concerning the note of M Pellat on the constitution of the atom Th **Tommasina** M Pellat has assumed that the atom as a whole is neutral from the electric point of view if this hypothesis is not true the further reasonings of M Pellat fall to the ground —An apparatus for measuring the flow of liquids M **Krebs** A description of a simple apparatus giving at any instant the flow of a liquid in litres per hour It has been successfully employed in measuring the consumption of petrol in trials of petrol motors—Remarks on the preceding note M **D'Arsonval** The apparatus is remarkable for its simplicity and exactitude, and will be of service in a great number of laboratory experiments —Positive light P **Villard** —The nickel tin alloys Léon **Guillet** Referring to a recent

publication by M Vigouroux on this subject, the author gives a *résumé* of work already published concerning the nickel-tin alloys by Guettier, Gautier, and himself —Some properties of the alkaline protoxides E **Rengade** At 400° C these oxides are decomposed into the dioxide and the metal, the latter volatilising Liquid ammonia converts them into mixtures of hydrate and amide Hydrogen at 180° C to 200° C reduces the oxides of rubidium, potassium, and sodium, forming a mixture in equimolecular proportions of hydrate and hydride —Contribution to the study of the oxybenzoates Œchsner **de Coninck** - Iodine derivatives of the methyl ethers of pyrocatechol F **Tassilly** and J **Leroide** —Sands and shingles of the Pas-de-Calais René **Bréon** A determination of the mineralogical composition of these sands and shingles shows that these minerals bear no relation to the rocks in the surrounding strata They arise from old igneous rocks the nearest deposits of which are 250 to 300 kilometres distant For the rocks and shingle the theory of ice transportation is a possible one but this explanation can hardly apply to the transportation of many millions of cubic metres of sand, and the cause of the appearance of the latter remains unknown —The artificial coloration of minerals Paul **Gaubert.** In opposition to the views of Suida, the author is of opinion that the artificial coloration of fibres of chrysotile and other crystallised minerals is a purely physical phenomenon —Tchernichewite, a new amphibole L **Duparc** and F **Pearce** —The presence of *Ustilago Maidis* on the adventitious roots of *Zea Mais* and of its *quadricolor* variety and on the biomorphoses which it presents M **Chifflot** —Observations on suprarenal fat V **Babès** —The purification of sewage by turf filters Henri **Pottevin** An account of experiments carried out for several months on a single filter The rate of filtration was 400 litres per square metre per day, and the purification effected, details of which are appended was very satisfactory —Contribution to the study of the food of the sardine Casimir **Cépède** —Characters of the intertropical atmospheric circulation L Teisserenc **de Bort** and L **Rotch**

DIARY OF SOCIETIES

THURSDAY, April 18

Royal Society, at 4 30 —On Reciprocal Innervation of Antagonistic Muscles Tenth Note Prof C S Sherrington F R S —Fatty Degeneration of the Blood S G Shattock and L S Dudgeon —(1) The Rate of the Assumption of Chloroform by the Blood during Anæsthesia (2) Function of the Red Corpuscles in Chloroform Anæsthesia Dr G A Buckmaster and J A Gardner —The Fermentation of Glucosides by Bacteria of the Typhoid-coli Group and the Acquisition of New Fermenting Powers by *bacillus Dysenteriae* and other Micro organisms F W Twort

Royal Institution, at 3 —The Birth and Affinities of Crystals Prof Henry A Miers, F R S

Linnean Society, at 8 —On the Œcologic Functions of Stolons and Cleistogamous Flowers J C Shenstone —On the Œcologic Aspect of Constitutional Variation in Fruit culture A O Walker —On an Aberrant Form of Coccidæ Hugh Scott —Some Results of Inoculation of Leguminous Plants Prof W B Bottomley —*Exhibits* Nepal Barley and other Cereals cultivated at High Altitudes in Tibet Dr George Henderson —Photographs of Sections of Woods J A Weale —Lantern Slides of Witches Brooms J Saunders

Institution of Electrical Engineers, at 8 —Flexibles with Notes on the Testing of Rubber A Schwartz

Chemical Society, at 8 30.—The Magnetic Rotation of Hexatriene, CH$_2$ CH CH CH CH CH$_2$, and its Relationship to Benzene and other Aromatic Compounds, also its Refractive Power Sir W H Perkin —Aromatic Azoimides Part I, *p* Hydroxyphenylazoimide M O Forster and H E Fierz —The Action of Hydrogen Peroxide on Potassium Cyanide O Masson —The Action of Ethyl Oxalate on Thioacetanilide and its Homologues S Ruhemann —Measurements of the Velocities of Saponification of the *l* Menthyl and *l* Bornyl Esters of the Stereoisomeric Mandelic acids A McKenzie and H B Thompson —Indican Preliminary Notice A G Perkin and W P Bloxam —Cupric Nitrite P C Ráy —The Constituents of the Essential Oil of American Pennyroyal Occurrence of a Dextro-Menthone M Barrowcliff —The Action of Tribromopropane on the Sodium Derivative of Ethyl Acetoacetate T E Gardner and W H Perkin

Optical Society at 8 —Presidential Address. Physical and Engineering Uses of the Microscope Walter Rosenhain

FRIDAY, April 19.

Royal Institution, at 9 —Nerve as a Master of Muscle Prof C S Sherrington, F R S

SATURDAY, April 20.

Royal Institution, at 3.—Studies in Magnetism Prof Silvanus P Thompson, F R S

The Essex Field Club (at Essex Museum of Natural History, Stratford), at 6.30.—Annual Meeting —On the Breeding of the Kite and Buzzard near Maldon in the Fifties and 'Sixties of Last Century Miller Christy —Memoranda on the Purple Sandpiper (*Tringa maritima*) Dr J Murie. —The Trees and Woodlands of Essex J C Shenstone

MONDAY, April 22

Society of Arts, at 8 —Detergents and Bleaching Agents used in Laundry Work Prof Herbert Jackson

Victoria Institute, at 4.30.—Exploration in Asia Minor, as bearing on the Historical Trustworthiness of the New Testament: Sir William M. Ramsay

Sociological Society, at 8.—The Future of Voluntary Charity C J Hamilton

TUESDAY, April 23.

Royal Institution, at 3 —Stimulation, Luminous and Chemical Prof William Stirling

Zoological Society, at 8 30

Society of Arts, at 4 30.—Social and Economic Conditions in Australia Dr John W Hackett

Institution of Civil Engineers, at 8 —*Continued discussion* —The Pyrmont Bridge, Sydney, N S W P Allan —Swing Bridge over the River Avon at Bristol W H B Saville

WEDNESDAY, April 24.

British Astronomical Association, at 5

Society of Arts, at 8 —Rubber Cultivation in the British Empire Herbert Wright

THURSDAY, April 25

Royal Society, at 4 30 —*Croonian Lecture* On the Essential Constituents of the Nucleus and their Relation to the Organisation of the Individual Prof J B Farmer F R S

Institution of Mechanical Engineers, at 8 —Address by the President T Hurry Riches

Institution of Electrical Engineers at 8

FRIDAY, April 26

Royal Institution, at 9 —New Illuminants James Swinburne, F R S

Physical Society, at 5 —Electrical Conduction produced by Heating Salts A F Garrett —The Influence of Pressure upon Convection Currents and a Criticism of J Stark's Relation between Cathode Fall of Potential and Temperatur W S Tucker —Solenoids which are turned by the Earth's Magnetic Field W B Croft —Simple Apparatus for mechanically illustrating the Tangent and Sine Laws J A Tomkins.

CONTENTS.

THURSDAY, APRIL 25, 1907

THE DEVELOPMENT OF CHEMICAL THEORY

A History of Chemical Theory and Laws By M M Pattison Muir Pp xx+555 (New York John Wiley and Sons, London Chapman and Hall Ltd., 1907) Price 17s net

THIS book, as the author remarks in several places, is not intended as a history of chemistry, but as an account of the development of chemical theory, an account of attempts "to describe, to set in due order, and to connect the changes of composition and the changes of properties which occur simultaneously in systems of homogeneous substances, and the conditions under which these changes proceed" Or as the author again expresses his intention, it is "to trace the forms which the two fundamental inquiries of chemistry have presented at different periods, to describe some of the methods which have been used to find answers to these inquiries, and to set forth the general results of the application of these methods" The two fundamental inquiries relate to the questions, "What is a chemically distinct substance?" and "What happens when chemically distinct substances interact?"

These questions are treated historically In answer to the first, the author deals with the "recognition of homogeneous substances, and the description of chemical changes as the interactions of those substances, the marks of elements and compounds, the laws of chemical combination, the atomic hypothesis, the molecular and atomic theory, the composition of homogeneous substances—allotropy, elements which do not react, and chemical nomenclature and classification" In answer to the second question, an account is given of "the classification of homogeneous substances, acids, bases and salts, radicals, types, dualism, the unitary hypothesis, chemical equivalency, isomerism and constitutional formulæ, the hypothesis of ionisation, the periodic law, the conditions and laws of chemical change, chemical affinity, chemical equilibrium, and lastly, the elucidation of chemical reactions by measurements of physical properties"

In pursuit of this plan, the author treats first of ancient conceptions up to the year 1780, Lavoisier's systematisation is next considered, then follows a historical sketch of the doctrine of atoms, leading to the differentiation of the atom and the molecule An account of more modern work is here introduced, in which the van 't Hoff-Arrhenius extension of gaseous laws to dilute solutions is gone into in some detail, and the conception of a molecule having been developed, allotropy is treated of as due to molecular complexity or arrangement The inert gases of the argon group are next mentioned, and in an appendix chemical nomenclature and notation

In the second part of his book Mr Muir discusses the classification of substances into acids, bases, and salts, he describes the development of the theory of types and radicals, leading to chemical equivalency; and he extends these conceptions to cover the field of molecular structure, dealing with isomerism and constitutional formulæ

The next section treats of ionisation, then follows a short account of the periodic classification In a third section the subjects considered are chemical affinity, chemical equilibrium, the relations between the physical properties of substances and their chemical reactions, as exemplified by their optical properties and their thermal behaviour

These subjects are illustrated by suitable extracts from the works of the investigators who forwarded the theories Quotations from Boyle, Priestley, and Lavoisier give an idea of these authors' styles, and render clear the subject-matter which is under discussion To give an instance —

> "To-day it is possible to recognise a certain resemblance between the saying of Stephanus of Alexandria (about 620), 'it is necessary to deprive matter of its properties in order to draw out its soul' and the statement of Lavoisier (1789) that the object of chemistry is 'to decompose the different natural bodies and to examine separately the different substances which enter into their combination' The first statement rested on a sweeping and superficial glance over an intricate maze of occurrences, and it produced little accurate knowledge The second statement was a result of the penetrating study of a few detached events, it was a translation of the first statement into expressions which could be directly applied to a vast number of particular phenomena, and in a few years it produced a science"

So far as possible the authors alluded to tell their own stories, and the reader's attention is directed by Mr Muir to the salient points in their conclusions

It is better, on the whole, to treat chemical science as Mr Muir has treated it, in following out the history of the development of each idea, so far as that is possible, than to attempt a chronological history, the one is the philosophy of history, the other is apt to be overburdened with unconnected detail A third plan is the biographical one, to select certain chemists who have contributed to the advancement of their science and to show by an account of the life-work of each, how far discovery has been furthered There are difficulties in all methods of treatment, probably the one chosen by Mr Muir tends most towards lucidity

In his preface, Mr Muir writes —

> "Some may say I have omitted much that is important, others may think I have included not a little that is trivial In such matters a writer must use his own judgment, after he has trained it to the best of his ability"

And at the beginning of the chapter on chemical equilibrium, he says —

> "He who would describe in detail the historical development of chemical equilibrium must be a chemist, a physicist, and a mathematician, he must be a man of great learning, vast audacity, and much literary ability"

In his own judgment Mr Muir is quite unable to attempt the task, but his estimate is too modest It must certainly be acknowledged that he has displayed great learning and much literary ability As to the audacity, it is for himself to judge W R

NIGER DELTA NEGROES

The Lower Niger and its Tribes By Major Arthur Glyn Leonard Pp xxii+564 (London Macmillan and Co, Ltd) Price 12s 6d net

THERE is about this book, which is undeniably interesting, a certain haziness in its preliminary observations, a lack of sharpness in its detail, in the geography and natural history, which suggests a photograph slightly out of focus You get a general idea of the scene, but you cannot be quite sure as to the species of the trees or flowers, or whether it is horses or cows that are feeding in the distant fields This want of exactitude is probably due to the fact that the author has seemingly allowed several years to elapse since his departure from the Niger delta before transcribing his remembrances from his notes

The book, in its good features and in its faults, is a rather striking example of the new school of literature dealing with negro Africa which has arisen since the publication of Mary Kingsley's West African studies This remarkable woman founded a new school in African studies which in some directions—politically more especially—has wrought much good In convincing the British white man—official, missionary, or merchant—that the black is not the half-animal savage which many unthinking people had considered him to be, that there is much good in his native ideas of religion and social economy, Mary Kingsley came near to being a genius, for she grasped and expressed many truths about the negro of West Africa which had been perceived by those who did not write or speak, and had been overlooked by many who did both Her gift of intuition enabled her to arrive at these conceptions with very little help from language In her two or three years spent on the West Coast of Africa she never mastered a sentence in any African language, and all her inquiries were conducted through English-speaking interpreters Those, therefore, who have had more scientific training in the affairs of Africa cannot always bring themselves to agree with Miss Kingsley's statements or with the deductions drawn therefrom, but she carries conviction in so much of her work that it is not necessary to attack it as a whole In a journal of exact knowledge like NATURE it is as well, however, to put ethnologists on their guard, to demand the utmost precision of statement from new writers on African subjects, even perhaps to beg of those writers to furnish an array of accurate and useful facts, and not attempt to add their own deductions, which may be based on a very limited knowledge either of Africa or the human race in general

Miss Kingsley's disciples are too fond of coining words in "ism" and "ality," and out of these they create a windy philosophy of German nineteenth-century type which they then declare to be the true meaning of African religious ideas. In one book—not that under review—much of this philosophy is based on a series of sentences in a native language, the words for which, though correctly taken down, are followed by a translation which is often incorrect and misleading Major Leonard in one chapter has cited a number of interesting proverbs and several fables, but he does not tell us from which tribe each is drawn, and his work would have carried more conviction if he had given the actual rendering in the native language, so that specialists could have satisfied themselves as to the correctness of the translation

There is a good deal more accuracy and definiteness in the way the author traces the history of the Ibo and Jekri and Efik peoples, and he imparts much useful and novel information regarding the Ijo tribe, which not differing physically from the other negro inhabitants of the Niger delta, nevertheless possesses a language of very isolated type with no clear relationships The descriptions of the native gods and the spirits who are believed to exist in trees, earth, water, and sky are valuable, and, so far as the reviewer can judge, accurate, moreover, they are given in a manner and style certain to arrest and retain the reader's interest "Horrors" are dealt with in sober language, but some of the incidents cited might be the nucleus of powerful stories such as Grant Allen used to write To those writers of fiction who place their stories in Africa, Major Leonard's book will supply many a sensational episode, while at the same time keeping within the limits of actual fact

Much interesting matter is also included dealing with the languages of the Niger delta and of Old Calabar The reviewer, however, cannot quite endorse Major Leonard's theories as to etymology and the inter-relationship of certain language groups, but these theories are presented without dogmatism, and are worth consideration

The book is therefore interesting, and more than half of it consists of a well-presented statement of the religious beliefs, manners, and customs of the Ibo people more especially, and also of the Ijo, Jekri, Efik, and Ibibio If Major Leonard could have omitted some of the preliminary chapters dealing too much with speculative philosophy and have confined himself to the interesting statement of his own personal observations, he would have produced a work of compact value Even as it is, those engaged in African research will find it an excellent guide in studying the negroes of the Niger delta

H H, J

PRACTICAL PLANT-PHYSIOLOGY.

Vorschule der Pflanzenphysiologie, eine experimentelle Einführung in das Leben der Pflanzen By Prof L Linsbauer and Dr K. Linsbauer Pp xiv+255 (Vienna Carl Konegen, 1906)

THIS book consists of instructions for the performance of 295 experiments in plant physiology in the widest sense It includes, not only the physiology of nutrition and movement, but also a

section on reproduction which takes in the mechanism of pollination, asexual reproduction by means of bulbils, experiments on regeneration, on the behaviour of potato tubers, and on grafting. The instructions are well arranged, and they form, with accessory explanations, a fairly continuous whole. A useful appendix is added, in which the needful outfit in apparatus and reagents is given, together with hints on laboratory methods. The book is intended partly for the "cultivated layman" and partly for the students of the Gymnasium and Realschule. It will, however, prove useful to the teachers in English universities, as well as to others who have discovered the wisdom of making even advanced students perform for themselves elementary experiments.

We are inclined to think that the cultivated layman will be frightened by the first twenty pages of the book, which contain a large number of rough qualitative estimations of the chemical compounds occurring in plants. This is excellent for the laboratory, but is hardly readable by one who does not repeat the experiments—and we cannot imagine the cultivated layman working his way through them. This, however, is not the fault of the authors, and it is only fair to say that the book in general is far from being unreadable.

In a future edition the authors would be well advised to give scientific names, if only for the sake of foreign readers, who cannot be supposed to know what plants are meant by *Sommerwurz* or *Mauerpfeffer*. In some few cases the instructions want a little re-editing. Thus, in exp. 123, p. 82, the student is directed to compare the assimilation of a withered leaf with that of a fresh one, but he is not told that the absence of assimilation in the withered leaf is due to the closure of its stomata. The experiment is, in fact, incomplete; what is missing is a repetition of Stahl's proof that the leaves of certain plants the stomata of which do not close on withering are capable of assimilating in that condition. At p. 45 the treatment of the function of the stoma in gaseous interchange is not all that could be wished. The reader will have a singular view of Brown and Escombe's researches if his knowledge is confined to what he can learn in the present volume.

The experiments (p. 52) on the effect of freezing leaves would be more instructive if the ice-injection of the intercellular spaces were studied on a hardy plant such as ivy. In the second experiment, on p. 78, a Tropæolum leaf is recommended for use in experiments on the passage of air through vegetable membranes. But this is hardly allowable, since the leaf in question is well supplied with stomata on both surfaces.

In spite of a few oversights in its pages, we do not hesitate to recommend the work of the brothers Linsbauer to our readers. The methods prescribed are simple and trustworthy, and the book has a merit which is rare in text-books, namely, that it is obviously written with sincere interest in the problems set before the learner.

F. D.

SOME RECENT MATHEMATICAL WORKS

Space and Geometry. By Dr. Ernst Mach. Translated by Thos. J. McCormack. Pp. 148. (London: Kegan Paul and Co., 1906.) Price 5s. net.

Irrational Numbers and their Representation by Sequences and Series. By Dr. Henry Parker Manning. Pp. vi+123. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1906.)

Auslese aus meiner Unterrichts- und Vorlesungspraxis. By Dr. Hermann Schubert. Vol. iii. Pp. 250. (Leipzig: G. J. Göschen, 1906.)

Leçons de Géométrie supérieure. By M. E. Vessiot. Pp. viii+322. (Lyons: Delaroche et Schneider; Paris: A. Hermann, n.d.) Price 12 francs.

La Géométrie analytique générale. By H. Laurent. Pp. vii+151. (Paris: A. Hermann, 1906.) Price 6 francs.

N. H. Abel, sa Vie et son Œuvre. By Ch. Lucas de Peslouan. Pp. xiii+169, with portrait. (Paris: Gauthier-Villars, 1906.) Price 5 francs.

Theory of the Algebraic Functions of a Complex Variable. By Dr. John Charles Fields. Pp. vii+186. (Berlin: Mayer and Müller, 1906.)

Recherches sur l'Élasticité. By P. Duhem. Pp. 218. (Paris: Gauthier-Villars, 1906.)

IF reform of mathematical teaching is to mean anything real, it is necessary that the teacher should possess a much more extended survey of his subject than is conveyed in the ordinary English text-book. There could be no more suitable book for giving the elementary or secondary teacher some intelligent ideas about geometry than Dr. Mach's series of essays. In them the subject is treated in its physiological, its psychological, and its physical aspects.

The first essay thus deals with the relation of the spatial concept to the senses. In the second we have an attempt to trace the natural development of geometry from psychological causes, while the last essay discusses the subject from the point of view of physical inquiry. Incidentally, a number of illustrations are introduced, some of which are admirably adapted for teaching purposes. There could not be a better object-lesson in the elementary properties of Euclidean space than the indefinitely extended pavement formed of equal and similar triangles discussed on p. 59. From it can be read off all the principal properties of parallels and parallelograms, the relation between the three angles of a triangle, and also the main properties of similar triangles the sides of which are commensurable.

Dr. Manning's book on irrational numbers contains a presentation in a simple form of another field of mathematical inquiry, such as is also eminently suited for placing in the hands of the ordinary schoolmaster. We have decided that the geometry of proportion shall be taught to schoolboys without reference to irrational quantities, but we have not yet eliminated a spirit of reckless extravagance in the quite unnecessary use of infinite series, often with total disregard for their convergency. In Dr. Manning's treatment an irrational number is defined

as forming a point of separation between rational numbers of two classes, the numbers of one class being less than those of the other This definition appears to involve the assumption (pp 7, 10, &c) that the point of separation is unique, in other words, that there cannot be two irrational numbers which have not some rational number separating them Perhaps this assumption may be regarded as a definition of equality of irrational numbers, in any case, the inquiring reader would find it necessary to examine more fully the references to Dedekind's and Cantor's writings given on p 56 Once the assumption or definition is made, the representation of numbers by sequences readily follows The theory of limits is discussed on p 57, and in the following chapter the notion of a sequence is shown to give rise to that of a series The remaining portion of the book is mainly devoted to the study of convergence, and includes the well-known multiplication theorem and applications to the still better-known binomial and exponential series

Prof Schubert is rightly regarded as an authority on the teaching of mathematics, but if this description leads the English reader to expect that the present selection of lecture notes will consist of a mere repetition of the "school geometry" and "graphs" which are being ridden to death in England to the exclusion of other equally important reforms, that reader will be greatly disappointed Dr Schubert has rather shown us what can be done by any teacher who will endeavour to make himself "a snapper up of unconsidered trifles" He finds, in the first place, that the determination of centres of gravity is not well treated in text-books either on mechanics or on the calculus, accordingly, this problem forms the subject of the first section The discussion includes curves, areas, and figures of revolution, and we notice the three- and four-cusped hypocycloids, the lemniscate, the kissoid, and other well known curves figuring among the worked-out examples Next follows a chapter on Snellius's law of refraction Some properties of the parabola deduced from the equation of the tangent are next discussed Then follow certain stereometric problems, and in particular an extension of Simpson's rule for the volume of a frustum Each of these sections deals with points which are not satisfactorily treated in existing text-books The book concludes with some interesting problems in spherical trigonometry, in particular the "Heronic" triangle in which the sines and cosines of the sides and angles are rational fractions The book is interesting reading, and quite easy for anyone with an elementary knowledge of the subjects discussed, to follow

"Leçons de Géométrie supérieure" consists of a collection of lecture notes on a course delivered in 1905–6, and transcribed by M Anzemberger The notes are *type-written*, not printed, and we can only wish that a similar method of procedure could be adopted with the mass of dry, uninteresting, superfluous, and wholly irrelevant details which so often occupy pages of printing in modern published "researches" The course can be precisely described to English readers as "solid geometry of curves, surfaces and complexes." It deals mainly with the large subject of curvature, but, in addition to considering systems of lines, the author gives some elegant discussions of systems of spheres and circles. The present reviewer has for some time past given a course of lectures on solid geometry in which the curvature of curves is treated kinematically It is interesting to see this most useful and suggestive method adopted in the present notes, for example, in defining the osculating plane as the plane containing the tangent and the acceleration

M Laurent's book also deals with analytical geometry, mainly solid geometry, but treats principally those portions of the subject which are studied before curvature It has for its object the development of geometry from a purely abstract point of view independently of any preconceived notions regarding space It is thus based on the study of orthogonal transformations and quadratic forms, and an instance of the spirit of the book is afforded by the preliminary note, in which the periodicity of the circular functions is derived from their definition as exponentials apart from any consideration of their geometrical properties The subject-matter includes the study of tangents and envelopes, the properties of surfaces of the second degree, their diameters and polars, the principle of duality, and a final chapter on the non-Euclidean spaces of Riemann and Bolyai The author at the outset advises his readers to make a clean sweep of all their previously acquired geometrical notions It is pointed out that in order to pass from the abstract to the concrete one definition is required, namely, the definition of rigid-body displacement This definition is to be regarded as *fundamental*, and as superseding Euclid's axiom of parallels Among the applications we notice Abel's theorem and an important theorem of Chasles

The story of Abel's life has been told recently in more than one book, yet it is a story that well bears re-telling if for no other reason because it ought to be read as widely as possible It is natural that M de Peslouan should give considerable attention to the part of Abel's life which was spent in Paris, and in a concluding chapter he offers some reflections as to the causes which led to Abel's great memoir being neglected at the time it was offered to the academy To understand these causes, M de Peslouan considers it is only necessary to study the trend of mathematical thought in Paris about the year 1826 At that time French mathematicians were too much engrossed with applied mathematics—such as dynamics and electricity—to give heed to a paper dealing with a property of transcendental functions, and thus nobody understood or appreciated the value of Abel's work The author further cites the parallel case of Galois as another unappreciated mathematical genius who interested himself greatly in Abel's work It might be easy to cite other examples, such as Grassmann The misfortune is that there is nothing to prevent a recurrence at the present time of the circumstances which led to Abel's dying in poverty without obtain-

ing any adequate recognition of the work which in later days caused his name to be handed down to posterity.

Of the remaining two books on our list a great deal might be said, but it would be difficult to give more than a bare statement of their contents in a general review of the present character. Dr. Field's development of the theory of algebraic functions by algebraic methods occupies a useful place in the literature of the subject, and is well adapted for use as an introductory treatise. In the matter of exposition, the summaries at the commencement of each chapter are valuable. The subject-matter includes a discussion of the Riemann-Roch theorem, Plucker's formulæ, and the Abelian integrals. The development of the theory, which is applicable to algebraic equations of the most general character, culminates in the complementary theorem, from which such applications as those just mentioned follow as corollaries.

Prof. Duhem's treatise has for its object the study and analytical expression of the equations of a material medium for displacements and stresses of a more general character than those considered in the ordinary analysis of stresses and small strains. It thus takes account of finite strains and of viscous in addition to elastic resistances. It includes the study of isothermal and adiabatic changes. The problem of wave propagation is discussed at considerable length, and in particular the conditions for permanence of wave motion. Hysteresis is not taken into account. The problem is a generalisation of that dealt with in 1874 by Dr. Oskar Emil Meyer. Some time back a small elementary treatise was reviewed in NATURE dealing with a somewhat cognate subject, namely, the classification of the various phenomena that can exist in a deformable medium, and the present treatise may be conveniently described as an analytical discussion of the x, y, and z equations, while the little book in question explained the A, B, C of the subject.

G. H. B.

OUR BOOK SHELF

Arboriculture Fruitière. By Léon Bussard and Georges Duval. Pp. xii+562, illustrated. (Paris: Baillière et Fils, 1907.)

THE object of this little book, we are told, is to be useful to fruit-growers, and with that view to lay before the reader in a condensed but systematic form as complete a general view as possible of the scientific principles underlying practical methods of fruit culture.

The actual details of cultivation do not differ materially from those followed in this country, but there is a marked difference in the manner, and especially in the spirit, in which the several operations are carried out in the two countries.

Here the details of pruning, pinching, and the like are done in routine fashion, handed down from our predecessors and pursued because experience has shown the utility of the practice.

In France much more thought is given to the matter. The book before us affords an instance of this. The various shapes and positions which the buds assume and the circumstances in which they are formed are gone into with much detail, and we have descriptions of *lambourdes, dards, brindilles, cochonnets, bouquets de mai, chiffons, coursons,* and *bourses* for many of which we have no corresponding terms in English. Nevertheless, a knowledge of these details is essential to a rational system of pruning, and apart from their practical interest they should be carefully studied by those interested in bud variation and "mutation."

We do not think that botanists in general adequately recognise the great diversity that exists in the buds of a single tree. The study of a pear-branch or of a peach-shoot would form an excellent preliminary exercise to the investigation of bud-variation, and perhaps serve to restrain premature theoretical pronouncements. For this reason, apart from its practical utility, we can commend the work before us as well thought out and carefully written. The principal varieties are described, the illustrations are appropriate, there is a table of contents, and an index, the latter not so complete as it should have been.

Physikalische Kristallographie vom Standpunkt der Strukturtheorie. By Ernst Sommerfeldt. Pp. vi+132. (Leipzig: C. Tauchnitz, 1907.) Price 6 marks.

THE title of this book is somewhat misleading. According to the commonly accepted nomenclature of crystallography the book would be described as a geometrical account of the structure-theory with a few physical applications. The ground covered is hardly wide enough to warrant the name "physical crystallography."

The author's style and method are obviously modelled on those of Sohncke. His account of the 230 possible types of crystal-structure is descriptive rather than logical, and will appeal far more to a practical crystallographer who wishes to have some slight acquaintance with modern developments of the structure-theory than to a mathematician who regards the subject as an application of the group-theory. The latter will probably feel a little irritated at the absence of exactness in definition and completeness in proof. For instance, the "space-partitions" on which the argument is based are nowhere clearly defined, and the reason given (p. 65) for assuming fifteen of these partitions as fundamental is quite unconvincing. Surely the partitions should either be limited to the fourteen possible space-lattices or be extended to include such figures as Kelvin's fourteen-walled cell. Sohncke's systems are illustrated by photographs of excellent models, but such diagrams probably convey very little to a reader unless they are arranged for stereoscopic use. The author gives, however, figures showing the projections of these models on a plane which will doubtless be an assistance to the student, though they might with advantage be clearer.

The last forty pages of the book are devoted to a discussion of some physical applications of the structure-theory. Here the author appears at his best, and has some very interesting things to say on the subject of etched figures and rotatory polarisation. His suggestions on etching of low symmetry seem to be new; those on rotatory structure, twinning, &c., are to be found in other books, but the author has brought the argument well up to date. All this part of the treatise is well worth reading, except that in the chapter on crystals with a trigonal axis the real point at issue is a little obscured.

H. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Electrical Method of Extracting Soot from Air in Flues.

ABOUT two years ago I observed that a body positively electrified to 100 volts became covered with soot in a day, while a negatively charged body remained comparatively clean.

I have reason to believe that the observation was first made by Lord Kelvin many years ago, but it does not seem to be well known.

Our laboratory mechanic, Mr. Black, has recently applied this to cleaning air by inserting in an air-flue a sheet of wire gauze connected to the positive 250-volt supply.

The electrified wire gauze is very efficient in extracting the soot from the air, and the method provides a simple means of cleaning the air supplied to large buildings in towns where the air is laden with soot.

GEORGE W. WALKER.

Physical Laboratory, The University, Glasgow, April 16.

Paradoxes and Principles.

YOUR critic has written his notice of my "Paradoxes of Nature and Science" (NATURE, February 7, p. 341) without giving reasonable care to the examination of the book, and has in consequence made a damaging statement as to fact which is so extravagantly untrue that it goes far beyond the limits of fair comment.

He says that I neglect general principles in the explanation of paradoxes, and tells me how they ought to be explained, "... by showing that the abnormal phenomena are determined by precisely the same laws as the normal phenomena, to 'explain' why a balloon rises it is necessary to propound the general principles of gravitational mechanics and to show that it rises for the same reason as a stone falls. But Dr. Hampson eschews general principles."

This is grossly untrue. My book teems with statements of and references to general principles "propounded" in explanation of paradoxes, exactly on the system recommended to me. I have not undertaken to explain the rising of balloons—a thing not regarded by me or my acquaintances as paradoxical—but I have explained why water stands in an inverted tumbler, and have done it exactly on the lines prescribed by your critic, propounding, p. 85, the general principle of fluid pressure, "gases, like liquids, are fluids, and transmit pressure equally in all directions. The air, then, transmits in all directions the pressure due to its own weight, and it thus presses upwards beneath ..." and pp. 92, 197, the general principle of gravitational attraction:—"The ordinary meaning of the word 'weight' is an earthward-tending force which can be used as a measure of the quantity of material. It depends upon the mutual attraction between the material and the earth." "... the force ... must vary inversely as the square of the distance in correct agreement with the law of gravitation."

A few of the many other references to general principles invoked in explanation of paradoxes are as follows:—

P. 19, "Heat makes things expand."

P. 29, "It is a general law of nature that a moving body tends to keep moving straight on at the same speed."

P. 32, "... resists ... by virtue of the great law of inertia, the strong tendency possessed by all moving things to resist interference with their motion."

P. 33, "Like all other things, it tries hard to keep to its original direction of movement."

P. 78, "A fluid, when pressed upon ... transmits the full pressure equally in all directions."

P. 93, "... its tendency at any moment is, in accordance with this law of inertia, to go straight on."

P. 97, "... the centrifugal force increases in proportion to the square of the velocity."

P. 116, "The general principle that weights, in descending, cannot produce more power than they consume in being raised the same height."

P. 118, "All things with which we are acquainted have some heat."

P. 149, "The principle that it requires heat energy to convert water into vapour ..."

P. 154, "Gases and vapours are very poor conductors of heat."

P. 170, "The sudden expansion and conversion into vapour require much heat."

P. 179, "The great law of the conservation of energy."

P. 212, "The doctrine that no element could by any means be changed into anything else."

P. 211, The persistence of matter, stated in sixteen lines.

If your critic does not intend to maintain the nonsensical proposition that a book for popular reading by the uninitiated should bristle with quantitative formulæ, how can he say that in writing the above and many dozens of similar passages I eschew general principles? Is this his "idea of scientific method"?

His criticism, as a guess, was, of course, not unlikely to be true of a book for such readers as I had in view. But when a critic has not time to read the book entrusted to him for judgment, would it not be fairer to the journal and to the author if he excused himself from the task of preparing a notice?

Of the value of his criticisms as to style and method, which it would take pages to discuss, I leave your readers to judge by the circumstance that the one statement capable of being definitely tested by a few quotations shows such complete carelessness about facts as to render the critic, if not malicious, certainly incompetent.

February 11. W. HAMPSON.

A SCIENTIFIC "principle" is a proposition assumed to be true universally which is made the basis of deductions. I said that Dr. Hampson "eschewed general principles" in the sense that he does not expound these propositions or make them the basis of his "explanations."

In refutation of this statement Dr. Hampson quotes one paragraph and fourteen short sentences. (The *unquoted reference to p. 211 is not evidence.*) Presumably he considers these passages as convincing as any that he can find; certainly none could be more conclusive of the justice of my criticism. For of the fourteen sentences nine do not deal with principles at all, some of them state non-universal experimental generalisations, others particular cases of general theorems, of which no proof is offered. In the remaining five, two "principles" are mentioned, of which one, the conservation of energy, is merely named, but is nowhere propounded; the other "principle" is Newton's first law of motion.

In order to justify my contention decisively, it is really only necessary to point out (1) that for the last twenty years Newton's laws of motion have not been accepted as adequate principles of mechanics, and (2) that none of the attempts at stating the first of those laws is successful. However, I will make every possible concession and admit, for the sake of argument, that Newton's laws are "principles," and that Dr. Hampson has stated one of them. But then, where are the others? It is impossible to found mechanics on the first law alone. It is just because Dr. Hampson has neglected the second law, which introduces the conception of "force" and all its consequents, that his writings abound in confusion. Thus, in his longer quotation which he holds up as a model of exposition, he has left the imagination of the reader to divine the nature and effects of "pressure" and "force"; it so happens that in this case the ambiguity is not serious, but elsewhere it is extremely serious. It is appalling to think in what mazes he would have entangled himself if he had not been so discreet (but inconsistent) as to omit Pascal's famous hydrostatic paradox from his list.

I repeat, then, that Dr. Hampson has attempted to explain the results of science without enunciating its principles. With fifteen quotations at his disposal he can produce no better evidence against that judgment than four inaccurate statements of a single antiquated principle which was never regarded as a sufficient foundation for even one of the many branches of physics with which he deals!

THE REVIEWER.

EROSION AT NIAGARA.

IT seems to have been a matter of common observation among the early colonists of America that the Niagara Falls had receded from the escarpment at Queenston to their present position six miles up the gorge. In spite of the view then frequently held that ravines were to be accounted for by violent rendings of the crust, those six miles, even in the eighteenth century, were appealed to as a natural time-scale. It was, moreover, felt that the rate of recession might give us a measure of the antiquity of the earth. James Hall in 1842 established a series of marks and monuments to which subsequent surveys might refer, and Mr. G. K. Gilbert[1] now draws conclusions from the work of his predecessors in 1842, 1875, 1886, and 1890, and from Mr. W. C. Hall's re-examination of the edge for the United States Geological Survey in 1905. He reproduces some of Captain Basil Hall's drawings, made with a camera lucida in 1827, and interesting photographs taken from 1855 onward. The former, which appear to be of great accuracy, throw doubt on certain details of the map of 1842. Mr. Gilbert regards the survey of 1905 as of especial importance, since it is the last record of the Niagara River in a natural condition. "The Erie Canal is supplied with water from the Niagara River at Buffalo, the Welland Canal is supplied from Lake Erie, and the Chicago Drainage Canal draws water from Lake Michigan. All the water thus diverted is withdrawn from the cataract. So also is the water diverted from the river above the falls for factory purposes and for use in the generation of electricity" (p. 12).

The Horseshoe, the true head of the Niagara Gorge, about 1886. The notch in the farther margin was not present in 1827.

The really active line of erosion is at the lip of the Horseshoe Fall. Very little recession occurred here at the head of the gorge between 1827 and 1842, but the rate between 1842 and 1875 was about 4 feet per annum, and from 1875 to 1905 nearly 6 feet per annum (p. 15). "The distance through"—Mr. Gilbert writes "thru"—"which the Horseshoe Fall has retreated since it parted from the American Fall is about 2500 feet. Allowing 5 feet per annum as the rate of recession, the parting took place about five hundred years ago." The present average rate of recession of the American Fall is probably only 0.2 foot per annum.

Mr. Gilbert, in view of the importance of local and temporary conditions, such as the position of joints in the limestone shelf, wisely makes no estimate of the time that has elapsed since the falls occurred at Queenston. But his study will be welcome in the literature of geology and geography alike, since it deals with one of the most famous types of river-erosion in the world. G. A. J. C.

1 "Rate of Recession of Niagara Falls." By G. K. Gilbert, accompanied by a Report on the Survey of the Crest by W. Carvel Hall. Pp. 31+11 plates. (Bull. U.S. Geol. Survey, No. 306, 1907.)

A YEAR'S WORK OF THE CARNEGIE INSTITUTION.[1]

THE Carnegie Institution was founded, and endowed with 2,000,000l., in order "to encourage, in the broadest and most liberal manner, investigation, research and discovery, and the application of knowledge to the improvement of mankind." The year-book for 1906 contains a general report on the work of the year, and short abstracts of the special investigations in progress. To the reader it affords abundant opportunity of "fine confused feedin'", to the reviewer a mass of projects and results of which it is hopeless to give any adequate account.

The trustees' plan of campaign has not yet been thoroughly worked out, and, indeed, in detail at least, must vary with the time. At the outset they had hosts of applications for assistance in research. The universities and colleges of the United States are now largely staffed by men brought up on research, who find themselves without the time or the appliances for the work they have prepared themselves to do. It was natural that they should appeal to the institution for assistance and that the trustees should respond by making grants in aid to individual investigators on a somewhat extensive scale. But difficulties have made themselves manifest, especially in the supervision of miscellaneous investigations, and experience has convinced the trustees that there is a greater prospect of a valuable return from large projects carried on under the direct supervision of the institution than from minor projects entrusted to individuals. Accordingly, during 1906, while the larger projects have been increased, a smaller number of minor grants have been made than in former years.

There are at present forty-five of these minor projects in progress. They are for the most part researches in mathematical, physical, and natural science and in history, literature and philology, but they include also the preparation of such works as the "Index Medicus." The grants in aid of them range from 50l. to 2000l., and seem to be made for the provision of assistants, apparatus and materials, and for the publication of results. The total amount thus allotted during the year was about 19,000l.

The larger projects may be divided into four classes—astronomical, geophysical, biological, and economic and historical. Astronomy has always been

1 Carnegie Institution of Washington Year Book No. 5, 1906. Pp. viii+266. (Washington: Published by the Institution, 1907.)

a favourite researching ground in America Few of its larger universities are without observatories, and many of the smaller colleges possess them also The institution seems to aim at extensive schemes which are beyond the scope of the universities In the department of solar physics 28,000*l* has been expended on the buildings and equipment of the Mount Wilson Observatory, and the year's work under Prof Hale includes photography of the sun and of the spectra of sun-spots and flocculi, spectroscopic study of solar rotation, and bolographic study of solar absorption It is interesting to note that, notwithstanding its princely endowment, the institution is glad to announce a gift of 9000*l* for the provision of a mirror of 100 inches aperture for a great reflecting telescope, to be used for the analysis of the light from faint stars and nebulæ The second astronomical department, that of meridian astronomy, has been organised in the present year, and Prof L Boss has been appointed, with an appropriation of 40,000*l*, to superintend the preparation of a catalogue giving the precise positions of all stars down to the seventh magnitude As an essential feature of the work he is to establish a temporary observatory in the southern hemisphere

In the department of geophysics, the work has been conducted hitherto by individuals But their investigations on the flow of rocks, the elasticity and plasticity of solids, and mineral solution and fusion under high temperatures and pressures, have been so successful that an appropriation of 30 000*l* has been made for the purchase of a site in Azadia D C, and for the building and equipment of a laboratory In another geophysical department, that of terrestrial magnetism, Dr L A Bauer, with a grant of 11,000*l*, has been carrying out a magnetic survey of the Pacific Ocean, as well as of the island of Hainan and a number of islands of the southern Pacific

There are five biological departments The widest in scope is that of experimental evolution, under the direction of Prof Davenport, who has been provided with a laboratory specially designed for the study of the phenomena of heredity hybridisation, and mutation, "by substantially the same methods as those applied to the stars by the astronomer or by the chemist to inorganic matter" The director is hopeful of success, and has already some results to report, but he points out that "a decade is the smallest convenient unit of time for measuring the progress of the more important investigations now under way" The department of marine biology is under the direction of Dr A G Mayer, who has been provided with vessels, buildings, and docks and with the aid of specialist guests is studying the fauna of the Florida coast More novel in its aim is the department of desert botany, which has a domain and buildings in Arizona, and is directed by Dr D T MacDougall It is devoted to research on the flora of arid regions, and the influence of altitude and climate on vegetation The director is establishing small plantations at various heights above sea-level, and denuding areas here and there that he may study their re-occupation by desert plants He is also making systematic observations on the shores of an accidentally formed lake 500 square miles in area in the Salton Basin, California The channel between the lake and the Colorado River, by the overflow of which it was formed has now been closed, and during the gradual disappearance of the lake the re-occupation by desert vegetation of the areas left bare by the recession of the water is to be studied

The department of horticulture is on more ordinary lines, plant, flower, and fruit development forming its scheme of work The department of nutrition is less conventional in its character, its aim being to extend our knowledge of the physics and chemistry of normal nutrition and of the conditions and remedies for abnormal nutrition As in previous years, its work is entrusted to individual investigators —three, working on distinct lines—at whose disposal a sum of 3000*l* has been placed, but the provision of a special laboratory is under consideration [1]

Finally, we have the related departments of historical research and of economics and sociology Prof J F Jameson, who directs the former, is engaged mainly in the preparation and publication of guides to the materials for American history to be found in the archives of Washington, Cuba, Great Britain, and Spain, to be extended as soon as possible to France, Mexico, and Rome, also in the publication of documents bearing upon the history of the United States About 3000*l* has been allotted to this department during the year In economics and sociology, Dr C D Wright and his 130 collaborators, with a grant of about 6000*l*, have been making a bibliographic index to the public documents of the various States of the Union, and are studying population and immigration, agriculture and irrigation manufactures, transportation, labour and industrial movements, taxation, and the negro problem, with a host of questions which these subjects suggest, ranging from railway pools to the need of church federation in Vermont

It will be noticed that in the selection of larger projects the trustees have kept in view Mr Carnegie's expressed wish that not merely knowledge itself, but the application of knowledge to the improvement of mankind should be advanced Most of the departments which have been organised have a distinct practical bearing, and some, such as the desert botany and the terrestrial magnetism departments, have blocked out work of great importance from both points of view That the "mankind" of the articles of incorporation is being interpreted in the first instance in a somewhat local sense is natural Charity begins at home And it must be remembered that we are all interested in the ocean magnetic fields in which the great Republic has a special interest that we must all benefit by a thorough knowledge of the history and the social condition of the United States, and that year by year we are all becoming more painfully affected by those abnormalities of nutrition to which the strenuous life of her citizens is supposed to give rise

Little space remains to notice another department of the work of the institution, viz the issue and distribution of publications So far, fifty-seven volumes have been published, and thirty-one are now in the press During 1906 nineteen volumes appeared, the expenditure on them being about 8500*l* Lists of the publications are sent to about 10,000 individuals and institutions, but as the standard edition is 1000 copies only, but one-tenth of the 10,000 can be expected to respond This restriction to 1000 copies is the most un-American feature of the policy of the institution, and in the interests of the advancement of knowledge is to be regretted. No doubt even an endowment of 2 000,000*l* gives a limited income But if the scientific work which it produces is of value, the publications describing the work should be widely distributed And the president seems to take a perverse view of the question when, in order to meet anticipated criticism, he says:—"If the bibliophile has found reason for dissatisfaction in the distribution of the publications of the Institution he may be disposed to be lenient with the latter on learning that he is one of many thousands soliciting favors"

[1] Since the issue of the Year Book it seems to have been decided upon

AËRODYNAMICAL EXPERIMENTS AND OBSERVATIONS IN RUSSIA

THE results of an extensive series of experiments upon the resistance of various forms of bodies in a current of air, as well as the particulars relating to various balloon ascents and observations upon the height of clouds, are given in two publications recently received from the Institut aérodynamique de Koutchino.[1] The institute (Fig. 1) was founded for the purpose of studying air resistance and for the scientific exploration of different layers of the atmosphere. Besides the director and honorary members of the staff, there are in all twenty-one men employed, of whom six are labourers.

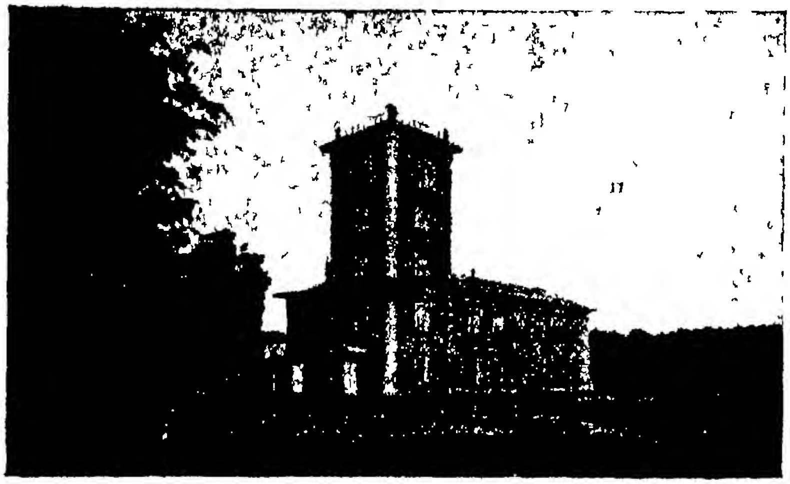

FIG. 1.—The Aërodynamic Institute at Koutchino.

The buildings and equipments cost 100,000 roubles. There is a dwelling house for the staff, a hall, 100 feet by 43 feet by 28 feet, for experimental work, and suitable workshops and tools.

The experiments upon air resistance were made in a long cylindrical tube 48 feet long and 4 feet diameter, shown in Fig. 2 (a piece of the tube is temporarily removed to show the position of a small screw inside). The air current in this tube is produced by an electric fan, the power coming in the first place from a thirty horse-power steam engine. It was found at first that the air current in the tube was not uniform, and was not even symmetrical about the axis of the tube, since greater proximity to the floor and one wall of the building produced a disturbing effect. This difficulty was overcome by inserting the end of the tube into a large cylinder 7 feet diameter and 12 feet long. The velocity of the air in the tube was carefully measured for various speeds of the fan, and subsequently the velocity for each experiment was obtained from the number of revolutions of the fan.

The weak point of this method is that the body which is being experimented upon in the tube presents an obstacle to the free motion of the air, and therefore reduces the velocity, and furthermore, the walls of the tube exert an unknown influence upon the result excepting for quite small bodies placed near the centre. With a similar arrangement at the National Physical Laboratory, Mr. Stanton found that working with a tube of 2 feet diameter he could not experiment upon a pressure plate of more than 2 inches diameter without finding that his results were vitiated by the influence of the walls of the tube.

It is impossible in a brief notice to give an account of all the experiments; perhaps the most important are those showing the increased lifting power which a screw possesses when a current of air is made to blow at right angles to its axis. Thus the lifting power with a horizontal current of 20 feet per second was found to be more than twice as great as with still air, although the driving power required was not increased.

Details of the methods and results of four ascents of unmanned balloons are given, and it is noteworthy that in a country like Russia the instruments should be so often recovered.

FIG. 2.—Tube for Experiments on Air Resistance at the Aërodynamic Institute, Koutchino.

The observations on clouds depend on the use of an electric search-light, and the observation, by a theodolite in the neighbourhood, of the position of the patch of lighted cloud. Unfortunately, the method can only be pursued at night, when the type of cloud is not very easy to determine.

[1] Institut aérodynamique de Koutchino (St. Petersburg, 1905.) Bulletin de l'Institut aérodynamique de Koutchino, Fascicule I. (St. Petersburg: Golicke and Willborg, 1905.)

The whole account will well repay a careful perusal, and anyone engaged on the design of a flying machine will find much useful information in the results of the various experiments on bodies rotating in a current of air

THE MEXICAN EARTHQUAKE

ANOTHER great earthquake has been added to the series which has marked the recent increase in seismic and volcanic activity along the Pacific coast of America At 11 30 p m on Sunday, April 14, or about 6 a m of April 15 by Greenwich time, the greater part of Mexico was visited by a destructive earthquake As usual, the first accounts were not only exaggerated, but gave an erroneous impression of the distribution of damage, Mexico city, which was represented as almost destroyed proved by later accounts to have been comparatively little damaged, while the towns of Chilpancingo and Chilapu, as well as some others not to be found in ordinary atlases, suffered great destruction The sea-coast towns from Salina Cruz to Acapulco suffered severely, and a portion of the latter is said to have been submerged The shock is reported as severe at San Luis Potori and Juan Batista though no damage was done at either place, these two cities are about 530 miles apart and about 350 miles from the region of greatest damage, so we may estimate the area over which the shock was sensible as extending to somewhere about 500 miles from the centre of the disturbance

The earliest reports stated that railway communication between Mexico city and Vera Cruz was suspended owing to the sinking of the permanent way, but this news, which has not been corroborated in later telegrams, is the only suggestion that the focus of the earthquake may have extended to any distance from the west coast Everything else points to the conclusion that it originated close to the shore-line of the Pacific, and was partly, if not wholly, submarine Sea-quakes are common in this region, sometimes they are felt by ships at sea though unnoticed on shore, and in at least one instance seem to have caused the loss of a ship The story is a remarkable one On October 3, 1902, the German barque *Freya* cleared from Manzanillo for Panta Arenas, nothing more has been heard of the captain or crew, but the ship was found twenty days later, partially dismasted and lying on its side There was nothing to explain the condition of the ship, but a wall calendar in the captain's cabin showed that the catastrophe must have overtaken it on October 4 not long after leaving port, as was also indicated by the anchor being found still hanging free at the bow Weather reports show that only light winds were experienced in this region from October 3 to October 5, but on the other hand, severe earthquakes were felt at Acapulco and Chilpanzingo on October 4 and 5 one of which probably caused the damage to the *Freya* which led to its abandonment

Prominence has been given in the daily papers to earthquakes in Spain and Italy, which occurred shortly after the Mexican one; but they were of an order the occurrence of which is too frequent to justify any direct connection between them and the greater one It may be different as regards the other two large earthquakes, which were registered at 9 10 p.m on April 18, and at 0h 11 a m on April 19, no news of these shocks has yet reached us, they must have been earthquakes of the first order of importance but are only known from distant records which are interpreted as showing that they originated at about 90° from western Europe This is about the distance of Mexico, but it is rare for after-shocks to be of as great magnitude as these; on the other hand, it is not uncommon for earthquakes to take place in groups, usually originating at nearly opposite points in the globe We may consequently, in the absence of news of a great earthquake in America or Japan, look for the origin of these two earthquakes in the North Pacific Ocean on the eastern part of the Malay Peninsula.

TUBERCULOSIS RESEARCH AND VIVISECTION

THE investigations conducted by the Royal Commission on Tuberculosis, contained in a second interim report recently issued,[1] would have been impossible without the use of experiments on animals, and the appearance of this report is most opportune, for, almost simultaneously, the Royal Commission on Vivisection has published the first volume of the minutes of evidence taken before it

As regards the investigations on tuberculosis, thirty different viruses isolated from cases of tuberculosis occurring spontaneously in bovines have been studied, and the results of introducing them into a number of different animals by feeding and by inoculation are recorded In calves, inoculation usually results in generalised progressive tuberculosis, but the effect is somewhat dependent on the dose, *i e* the number of bacilli administered Feeding, on the other hand, usually produces lesions limited to the neighbourhood of the digestive tract, which generally retrogress and become calcareous The bovine bacillus, when introduced into rhesus monkeys or chimpanzees either by inoculation or by feeding, induces rapid generalised tuberculosis, and considering the close relation that exists between the anthropoid apes and man, these results are of the highest importance In pigs generalised progressive tuberculosis is readily set up both by feeding with, and by the inoculation of, bovine bacilli Goats, dogs, and cats are relatively less susceptible, but more or less tuberculous infection can similarly be produced in them On this part of the investigation the commissioners remark that the bacillus of bovine tuberculosis is not so constituted as to act on bovine tissues only, and the fact that it can readily infect the anthropoid apes, and, indeed, seems to produce this result more readily than in the bovine body itself, has an importance so obvious that it need not be dwelt on

The viruses isolated from sixty cases of the disease in man have also been studied, and the results obtained show that they may be divided into two groups, subsequently referred to as group i and group ii The bacilli of group i were mostly obtained from cases of abdominal tuberculosis occurring in children, and the results produced by introducing them into animals are identical with those produced by the bovine bacillus The bacilli of group ii, obtained from various forms of human tuberculosis, grow more luxuriantly in culture than those of group i, and inoculated into calves and rabbits do not produce the generalised and fatal disease caused by the bovine bacillus, but in rhesus monkeys and in the chimpanzee set up a general tuberculosis Certain human viruses, differing in certain respects from those of groups i and ii, were also met with, and are classed as group iii, but an opinion on their significance is reserved for a future report

The commissioners conclude that the tubercle bacillus in its nutritive and reproductive powers re-

[1] Second Interim Report of the Royal Commission appointed to inquire into the Relations of Human and Animal Tuberculosis, Part I., Report Part ii, Appendix, Vol. iv, "Comparative Histological and Bacteriological Investigations." By Dr Arthur Eastwood

sembles other simple organisms, and that the essential difference between one strain and another depends on variations in these factors, and they therefore classify the bacilli as *dysgonic*, those that grow with difficulty on artificial media, and as *eugonic*, those that grow readily on the same media

The bearings of the results obtained are thus summarised:—

"There can be no doubt that in a certain number of cases the tuberculosis occurring in the human subject, especially in children, is the direct result of the introduction into the human body of the bacillus of bovine tuberculosis, and that in the majority of these cases the disease is introduced through cow's milk Our results clearly point to the necessity of measures more stringent than those at present enforced being taken to prevent the sale or the consumption of tuberculous milk" The details of the various experiments are published in the appendix, in which Dr Eastwood gives a full description of the histology of the lesions in the various animals inoculated, and of the bacteriology of the bacilli isolated from them, together with the methods employed This appendix is a volume of 300 pages, illustrated with tables and charts, and must rank as a first-rate piece of work Dr Eastwood concludes that there is an essential unity, not only in the nature of the morbid processes induced by human and bovine tubercle bacilli, but also in the bacteriological characters of the tubercle bacilli which cause these processes

As regards the minutes of evidence taken before the Vivisection Commission,[1] the witnesses so far called include Mr W P Byrne C B, who discussed the procedure of the Home Office in the granting of licences and in the administration of the present Act, Mr G D Thane Sir J Russell, and Sir W Thornley Stoker, the official inspectors under the Act, Mrs K Cook and Dr Snow, representing anti-vivisection associations, Mr Stockman, chief veterinary officer of the Board of Agriculture, and Prof Starling

As already suggested, the work of the Royal Commission on Tuberculosis, reviewed above, affords one of the most striking examples of the necessity for, and of the value of, experiments on animals, and the evidence so far given before the Vivisection Commission has brought out the fact of the scrupulous observance of the conditions of their licences by the various holders of the same, of the complete absence of that cruelty and callousness for which the experimenters have been assailed by those who advocate the abolition of vivisection, and of the absolute necessity for the experimental method in the medical and biological sciences if these are to advance The inspectors seem agreed that there is no need for more inspection in order to check abuses Surprise visits can be, and are paid at any time, and what each worker is doing is known to the Home Office

NOTES

The absence of official representatives of the British Government at the celebrations connected with the opening of the Carnegie Institute at Pittsburg formed the subject of questions asked in both Houses of Parliament on Monday The replies were to the effect that our Ambassador to the United States was prevented by other engagements from attending the celebrations, and Lord Fitzmaurice added —"I am exceedingly glad of the opportunity publicly to state how much His Majesty's Government, and our Ambassador at Washington, appreciate the importance of that occasion" In his explanation to the House of Commons Mr Runciman said —"Neither the German, Austro-Hungarian, French, nor Russian Embassies were represented at Pittsburg It is understood that the Universities of Oxford and Cambridge were represented at the celebrations at Pittsburg, and on such an occasion the presence of members of the greatest educational institutions of the country would appear to be the form of representation most suitable and convenient" The explanations do not appear to us to be entirely satisfactory That representatives of British universities were present at Pittsburg is not a circumstance for which the Government can claim any credit If these guests of Mr Carnegie had been asked to represent the Government on the occasion the case would have been different, but no official notice was taken of them or of the event When every allowance has been made, the fact remains that the German Emperor took advantage of an opportunity to show his interest in the advancement of knowledge, and that the British Government failed to do so

A MEDALLION in memory of the late Pierre Curie, by M Vernier has been placed on the wall of his laboratory at the Ecole municipale de Physique et de Chemie, Paris

ON May 6, 8 and 10, Prof W Wright will deliver three Hunterian lectures of the Royal College of Surgeons on "The Prehistoric and Early Historic Inhabitants of England"

DR G O SMITH has been appointed director of the U S Geological Survey to fill the vacancy caused by the election of Dr C D Walcott to the secretaryship of the Smithsonian Institution

ON Saturday next, May 4, Prof W C McIntosh will begin a course of two lectures at the Royal Institution on "Scientific Work in the Sea Fisheries" The Friday evening discourse on May 3 will be delivered by Sir James Crichton Browne on "Dexterity and the Bend Sinister" and on May 10 by Signor Comm Giacomo Boni on "Recent Excavations on the Forum Romanum, and the Forum Ulpium"

THE death is announced, on Saturday April 13, of Mr C L Griesbach C I E formerly director of the Geological Survey of India Born in Vienna on December 11, 1847, he was educated in the university of that city Afterwards coming to England, he was appointed to the Geological Survey of India in 1878 made director of it in 1894, and retired from the post in 1903 His most important geological work was done beyond the frontiers of British India, and especially in Afghanistan which he visited first with the Canadian field force in the Afghan war, again with the Afghan Boundary Commission in 1884–6 and for a third time as adviser to the Amir in 1888–9 His descriptions are still the only available sources of information regarding the geology of much of the country seen by him on these occasions The popular idea that a desire to avoid military service is the reason why foreigners settle in this country, was not borne out by Mr Griesbach who joined the British Army shortly after his arrival in England, saw active service in Candahar, was mentioned in despatches earned war medals and clasps, and was made a C I E for his services with the Afghan Boundary Commission

WE regret to learn of the death on Saturday last, of Mr George E Davis, the founder and editor of the *Chemical Trade Journal* Mr Davis was one of the original fellows, and subsequently a member of council, of

[1] Royal Commission on Vivisection Appendix to First Report of the Commissioners. Minutes of Evidence, October to December, 1906.

the Institute of Chemistry, a fellow of the Chemical Society, and he took a prominent part in the inauguration of the Society of Chemical Industry, filling in succession the offices of honorary secretary member of council, chairman of the Manchester section, and vice president Mr Davis contributed largely to chemical, technological, and microscopical literature His "Handbook of Chemical Engineering" was published in 1901, and his other collected works include "Sizing and Mildew in Cotton Goods" (written in conjunction with Dr Dreyfus and Mr Philip Holland) "The River Irwell and its Tributaries" (of which he was co-author with his brother, Mr Alfred R Davis), and numerous other miscellaneous pamphlets, lectures, &c From its commencement in 1887 he acted as editor in-chief of the *Chemical Trade Journal* Mr Davis was in his fifty-seventh year

AFTER a sojourn of nearly a quarter of a century in Brazil, Dr E Goeldi has felt it necessary to resign the directorship of the museum which now bears his own name at Pará He is succeeded by his colleague, Dr J Huber, who has hitherto had charge of the botanical section The State Government of Para has issued an appreciative notice of Dr Goeldi's services in connection with the museum

WE have received a copy of the *Photographic Monthly* for April, which contains reproductions of Mr J P Millar's photographs of young cuckoos in the act of ejecting their fellow-occupants of nests Most, if not all, of these pictures have already appeared in a little work by Mr W P. Westall which has been noticed in our columns

THE aphides of the genus Chermes infesting conifers in Colorado form the subject of the first article in the Proceedings of the Philadelphia Academy for the current year Several species occur which have life histories of the same general type as that of the European *Chermes abietis*, both hibernating and migratory females being produced New and other orthopterous insects from Arizona are described by Mr J A G Rehn in the second article

Two important articles are contained in the issues of *Biologisches Centralblatt* for March 15 and April 1, the one by Dr Max Wolff, on the spinal cord of the lancelet, and the other by Mr A Mordwilko, on the biological relationship existing between ants and plant lice In the former attention is specially directed to the morphology and genesis of the cord, certain very remarkable conclusions being reached with regard to the origin of its central canal The nature of "symphilism" and its relation to parasitism is discussed in the latter

AMONG the contents of vol xli, part iii, of the *Journal of Anatomy and Physiology*, special reference may be made to an article by Messrs A Keith and M Flack on the form and nature of the muscular connections between the primary divisions of the vertebrate heart One of the most important conclusions relates to the existence in mammalian hearts of a remnant of primitive fibres at the sino-auricular junction These fibres, which are intimately connected with the vagus and sympathetic nerves, have a special arterial supply and it is in them that the dominating rhythm of the heart is believed normally to arise Considerable interest also attaches to the description, by Mr G A Hill, of a female skeleton, apparently referable to the Bronze age, from a cave in Littondale, Yorkshire

IN discussing polygamy and other mating habits among birds in the March number of the *American Naturalist*, Dr R W Shufeldt refers to the imperfection of our knowledge on this subject in the case of many groups, stating for example, that he cannot find out whether kiwis and brush-turkeys are polygamous or monogamous. Although birds may be polygamists, monogamists, or in certain conditions given to practices similar to polyandry, or even, possibly, to polyandry itself, we have no information with regard to the origin, causes, and, in most instances, the needs of these divergent habits It is, however, more easy in many cases to explain the radical changes which take place in these respects as the result of domestication It may be added that the author disbelieves in the existence of any close relationship between kiwis and other struthious birds, or between the latter and tinamous "A kiwi (Apteryx)," he writes, "is no nearer an ostrich, and an ostrich to a tinamou, than a limpkin (Aramus) is to a bustard, and a bustard (Otis) to a quail (Colinus)"

IN the April number of the *Quarterly Review*, Prof J C Ewart, of Edinburgh, discusses recent opinions and theories relating to the origin of the modern horse After reviewing the early history of the horse-stem (throughout which the name Protorohippus is misspelt Proterohippus) the author states that he recognises three equine types as having existed in Europe about the close of the Glacial type, namely, the steppe, the forest, and the plateau type Without entering into the consideration of all the characteristics of these it may be mentioned that, according to the evidence of skulls from a Roman fort at Newstead the forest type is distinguished by the face being placed nearly in the plane of the basicranial axis, whereas in the steppe type (to which the Mongolian Przewalski's horse is stated to conform, if, indeed, it be not the exemplar) the former is sharply bent down at an angle to the latter According to the author, the skull of the celebrated thoroughbred "Stockwell" conforms very closely in this respect to the steppe type, and is altogether different from the plateau or Libyan type, although agreeing with the latter in the characters of the cervico-dorsal vertebræ If such mixed features really exist in one and the same skeleton, there would seem little hope of an early settlement of the problem of the origin of the thoroughbred

A MEMOIR on "Variation and Correlation in Ceratophyllum," by Prof Raymond Pearl, with the assistance of Miss O M Pepper and Miss F J Hagle, has been published by the Carnegie Institution of Washington The memoir deals, on somewhat novel lines, with the variation in the number of leaves to a whorl (and other characters), with especial reference to the laws of growth It is shown that the mean number of leaves to a whorl y is related to the ordinal position of the whorl from the base of the branch x by a relation of the form $y = A + B \log (x - C)$, the mean increasing rapidly at first and then more slowly For a branch of a given order the constant A alone varies in populations from different environments, *i e* the means vary but not the form of the law by which the successive whorls are differentiated In branches of successive orders the constant B tends to increase, the mean number of leaves to a whorl tending towards the final limit with greater rapidity in secondary as compared with primary branches The variability of the whorls decreases from the base of the branch onwards, successive whorls being produced "with ever-increasing constancy to their type, the ultimate limit towards which the process is

tending being absolute constancy," and an analogy is drawn between this law and the perfection of an action by repetition or practice The author believes that both laws are of considerable generality, and apply to other organisms

WRITING on the anti-opium drug in the Journal of the Federated Malay States Museums (December, 1906) Mr L Wray identifies the plant as *Combretum sundaicum*, and describes the method of making an infusion from the roasted twigs and leaves This is mixed with a decoction of burnt opium and it is possible that the latter supplies part of the curative effect In the same number Mr H C Robinson contributes a list of the birds found on the Aroa Islands, in the Straits of Malacca

REFERENCE is made to a new klinostat—the instrument used to counteract the influence of gravity—designed by Dr P van Harreveld in *Recueil des Travaux botaniques Néerlandais*, vol iii The author tested several instruments by means of an automatic chronograph device from which he concluded that a periodic irregularity could always be detected This is important, since the repetition of a very weak stimulus at regular intervals is cumulative and will in time induce curvature The essential features of the author's klinostat are that it is weight driven, the impulses being suitably moderated and regulation is effected by independent electromagnetic mechanism

IN his report for the year 1905 Mr J H Maiden the director of the botanic gardens and public domains Sydney, New South Wales, announces that the changes connected with the re grading of the botanic garden have been completed after five years' work Reference is made to the work of a previous director, Mr Charles Moore who died during the year Among the Australian garden plants that attracted attention when flowering were *Thymalium Billardieri* *Euroschinus falcatus*, and *Kennedya procurrens* the last being a new introduction of New South Wales origin

AN article by Mr R S Pearson on the level of sub-soil waters with regard to forests is published in the *Indian Forester* (February) Comparing the levels inside and outside forests, they are always higher outside, in an area of low rainfall the difference of levels is greater than where the rainfall is more abundant, and the level is steadier inside than outside the forest These results are explained by the facts that the trees intercept a portion of the rain water and make a heavier demand on the water supply than agricultural crops Sir Dietrich Brandis contributes a note on *Mastixia euonymoides*, with a figure of the stem section and Mr B O Coventry supplies photographs of the Changa Manga plantation in the Punjab, showing the cultivation of the *shisham* tree *Dalbergia Sissoo*

IT has been shown by Prof G Klebs that remarkable metamorphoses can be produced in plants by artificial methods of cultivation His latest contribution that was published in the *Abhandlungen der naturforschenden Gesellschaft*, Halle (vol xxv), gives some account of the results that he obtained Four species of Sempervivum were selected for experiment, because abnormality of structure has rarely been recorded for the genus The method consisted in removing the terminal inflorescences from plants that had been stimulated by heavy manuring or exposure to strong sunlight, when lateral flowers or inflorescences showing intense variation were developed Irregularities in number and shape of the parts of the flower, changes from one part to another, and vegetative developments occurred, perhaps the most striking being the combination of staminal and carpellary structures These and experiments with *Veronica chamaedrys* and other plants lead the author to the opinion that new *races* can arise as a result of changes in external conditions

FROM a second memorandum on the American gooseberry mildew (*Sphaerotheca mors-uvae*), just issued by the Board of Agriculture and Fisheries, we learn that during the winter of 1906–7 the presence of the mildew in certain gardens in Worcestershire was definitely confirmed and the cases investigated under the auspices of the Worcestershire County Council Reports sent to the Board have shown that the extent and seriousness of the disease are much greater than was at first supposed and in view of the increased danger of infection which arises when the mildew passes into its summer stage the Board advises all gooseberry growers to watch the plants closely during the summer months, especially those bushes which have been recently bought in order that the disease may be detected and dealt with at the earliest possible moment Gooseberry growers who have the least reason to suspect infection are advised to spray their bushes with a solution of liver of sulphur (potassium sulphide) from the time the leaves open until the fruit is set A solution of half an ounce to a gallon and a half of water is recommended for the first spraying and the strength should be increased to a solution of half an ounce to one gallon of water at the second spraying Details as to the examination and treatment of plants in order to prevent the spread of the disease are given in the Board's new circular, which can be obtained post free on application

THE Bulletin of the Manila Weather Bureau for August 1906 contains a reproduction of what is probably the only complete seismogram of the Valparaiso earthquake in existence The distance from the centres of the North Pacific and Chilian earthquakes of August 17 was such that the disturbance due to the former had practically died out before the arrival of the latter the first preliminary tremors commenced at 1h 13m Greenwich time and lasted until about 1h 21m The instrument being a Vicentini microseismograph with a vertical pendulum of 1.5 metres length, the third phase waves which give the greatest amplitude with a slow-period horizontal pendulum, are of small size, and it is largely due to this that the earlier phases of the record of the Valparaiso shock are so little complicated by the end portion of the preceding one

THE Geological Survey of Western Australia has issued another report (Bulletin No 24) of the special series dealing with different mineral fields of the State The report, which covers seventy-nine pages and the accompanying thirteen maps and twenty-six plates, represent the results of the work of Mr C G Gibson in the Laverton, Burtville and Erlistoun auriferous belt Mt Margaret Goldfield In Bulletin No 25 Dr R Logan Jack discusses the prospects of obtaining artesian water in the Kimberley district, Western Australia He passes in review nine distinct areas in which he anticipates more or less success in the search for artesian water

THE richness and complexity of its deposits have given to mining in the Cobalt district of Canada special interest and much valuable information regarding this new silver-mining district is contained in an admirably illustrated article by Mr J F Hardman in the *Engineering Magazine*

(vol xxxiii, No 1) The first discovery of silver was made in the district in July, 1903, and the progress made since that date is described in detail The characteristic rocks of the region are conglomerates of Lower Huronian age, through which, and sometimes through the underlying diabase, pass calciferous veins carrying metallic silver and sulphides or arsenides of silver with smaltite and niccolite, the arsenides of cobalt and nickel The veins occur along the main lines of fracture by which the conglomerate has been shattered As to the permanency of the deposits very different opinions have been expressed, but with increasing experience the trend of opinion is towards a long life for the district

IN addition to the usual record of measurements taken during the year 1906 at Epsom College, the report of the college Natural History Society for last year gives the average height, weight, and chest girth of all boys who have been measured in the ten years 1897–1906, and a chart showing average grades of development for the same period On the whole the average Epsom College boy would appear to be rather superior in physique than inferior to the average public-school boy One marked exception is evident in the curves for the ages 17 yr 10 mo to 18 yr 4 mo though it must be stated that the number of observations on which the curves are based is, for these months much smaller than the rest Boys at Epsom College between these ages however during the last ten years appear to have been on a lower physical grade than at other ages The other contents of the society's report show that excellent field work continues to be done by the members, among whom geology, botany and meteorology appear to be equally popular

THE subject of the perception of relief was discussed in letters to NATURE of January 3 and 31 last (vol lxxv pp 224 and 321), and the same question is raised in a communication received from Mr R T A Innes of the Transvaal Meteorological Department Mr Innes describes a method of seeing stereoscopic pictures in relief without the use of a stereoscope explained to him by Colonel W G Morris If while steadily viewing a distant object an index finger be held before the eyes, two images of it are seen if now the other index finger be held before the eyes also, four images will be seen By a little adjustment of the distance of the fingers from the eye the two central images can be superposed The substitution of a stereoscopic picture leads to similar results, and the superposed images give the idea of relief

MR F A LINDEMANN and Mr C L Lindemann writing from Darmstadt, describe a new glass which is transparent to rays of very short wave-length They have found that lithium biborieum, $Li_2B_4O_7$ (ordinary borax in which the sodium is replaced by lithium), when fused produces a clear glass which shows no appreciable absorption in the ultra-violet spectrum above 2000 Å The aluminium line 1856 is distinctly visible, though somewhat weakened if the glass be too thick In order to determine the absorption below this a vacuum spectrograph would naturally be required, as the air absorbs any lines shorter than 1856 The refractive index for the D-line $n=1\ 5389$ the dispersion Δ between c and F, $\Delta=0{\cdot}00847$, and $\nu=n-1/\Delta=63\ 7$ As might be expected, owing to the large percentage (82 5) of boracic acid, the dispersion toward the red side of the spectrum is fairly large, whereas that toward the violet side is very small The glass is extremely transparent to Rontgen rays, which it lets through, roughly, ten times as well as ordinary glass The specific gravity is 2 2, the hardness, 6. The glass can be cut and polished without difficulty. The cubical expansion coefficient (calculated from the constants of Winkelmann and Schott) is $118\ 10^{-7}$, about half that of ordinary glass It has been found that, as a general rule, the transparency for rays of short wave-length increases in analogous salts as the atomic weight of the metal decreases, but sufficient experimental data have not yet been obtained to warrant the publication of a definite formula

A NEW high-tension condenser on the Moscicki principle is likely to prove a useful commercial apparatus if, after testing in practical work, it fulfils the advantages claimed for it in a very complete and interesting pamphlet which we have received from Messrs Isenthal and Co, who are agents for the makers A condenser made on this principle is now on view in London, and the construction is very neat and convenient, any number of condenser elements being grouped together in a battery very easily according to the voltage required The chief advantages claimed over other condensers are the (1) strengthening of the dielectric to minimise the chances of rupture, (2) perfect contact between dielectric and armature plates, (3) prevention of local heating by means of a cooling chamber, (4) no organic substances used These condensers have been used successfully for the protection of live wires against atmospheric discharges, wireless telegraphy, suppression of lag in alternating currents and in X-ray work, and the construction of the condenser certainly renders it much less liable to breakdowns, which in practical work prove very serious The opening in wireless telegraphy work alone for a condenser which can be depended upon is very great, and the new condenser will no doubt be given a thorough trial in many ways as a practical commercial condenser has long been demanded

A SECOND communication on anode rays is published by Messrs Gehrcke and Reichenheim in No 4 of the *Verhandlungen* of the German Physical Society (compare NATURE, this vol p 173) An arrangement of apparatus is described by means of which the phenomena produced are made very striking by using high potentials obtained with anodes permitting of more continuous working in a high vacuum A brilliant fluorescence is observed on permitting the "rays" from the anode to impinge on a mica screen or on the glass walls of the vacuum tube The colour of the fluorescence is the same as that of the emission spectrum of the metal present in the salt used at the anode, thus with lithium carbonate the light is reddish in colour, and in the spectroscope shows the red and orange lines of lithium The admixture of another substance, such as graphite or zinc dust, with the salt used as anode facilitates the formation and improves the character of the rays It is noteworthy that the anode rays cannot be produced from a cold anode, and that usually some interval elapses, during which heating occurs, after the current has been switched on before they make their appearance The volatilisation of the salt may therefore play an important part in their production

SINCE "synthetic" indigo was put upon the market in 1897, some uncertainty has existed regarding its tinctorial value as compared with the natural dyestuff The makers of synthetic indigo have maintained that the only significant constituent of natural indigo is indigotin, identical with the synthetic substance, and that the other components present in the natural dye are either inert or harmful impurities On the other hand, certain practical

dyers have held that the natural dye gives a certain richness of shade, or "bloom," which is invariably absent from goods dyed with synthetic indigo. The results of a practical dye test of the two materials, made with the object of throwing light on this disputed question, are described by Mr. Cyril Bergtheil in a report to the Bihar Planters' Association. The conditions were such as to be strictly comparable for the two materials as regards concentration of dye bath, temperature, and fabric dyed. The results obtained, working on the large scale under practical conditions and with dye baths of the same strength, were such as to uphold the objection of the dyers already referred to against the synthetic dye. Natural indigo not only gave a richer shade with the characteristic "bloom," but also actually a darker shade. The difference between the natural and synthetic material, which is hardly apparent in dyeing trials made on the small scale, appears to become of considerable importance under conditions such as exist in actual practice.

The third fasciculus of the first volume of Prof. O. D. Chwolson's "Traité de Physique," which is being translated from the Russian and German editions into French by M. E. Davaux and supplied with notes on theoretical physics by MM. E. and F. Cosserat, has been received from M. A. Hermann, of Paris, who is publishing the work. Two previous parts of this excellent treatise were reviewed at length in our issue for February 15, 1906 (vol. lxxiii., p. 362), and it is unnecessary on this occasion to say more than that the present part deals with the liquid and solid states of bodies, and maintains the same high standard which characterised the previous issues.

The Chemical Publishing Co., of Easton, Pa., has just published "Inorganic Chemistry for Schools and Colleges," by Mr. J. L. Howe. The book is an enlarged and revised edition of "Inorganic Chemistry according to the Periodic Law," by Prof. F. P. Venable and Mr. Howe. The number of experiments has been increased, and prominence has been given to the applications of chemistry. The book is published in this country by Messrs. Williams and Norgate.

In the new issue of section i. of the catalogue of Mr. Charles Baker, of High Holborn, London, microscopists will find detailed information of a great variety of microscopes and accessory apparatus.

A sixth edition of "The Essentials of Chemical Physiology" by Prof. W. D. Halliburton, F.R.S., has been published by Messrs. Longmans, Green and Co. The book has been subjected to a thorough revision, and many parts have been re-written in order to incorporate recent advances in the knowledge of the proteins and of the way they are utilised in the body, together with the results of other researches.

The authorised English translation of Dr. Ludwig Jost's "Lectures on Plant Physiology," done by Prof. R. J. Harvey Gibson, of Liverpool, will be issued very shortly by the Clarendon Press. The Press also announces the second volume of Dr. Paul Knuth's "Handbook of Flower Pollination," translated by Prof. J. R. Ainsworth Davis, of Aberystwyth, containing an account of all known observations upon the pollination of the flowers of plants of arctic and temperate zones.

A third edition of the late Mr. Herbert E. Wright's "Handy Book for Brewers" has been published by Messrs. Crosby Lockwood and Son. The first edition, which appeared in 1892, was reviewed in Nature for November 24, 1892 (vol. xlvii., p. 75). In the present issue, not only has the size of the volume been increased by more than fifty pages, but very many paragraphs have been re-cast and fresh matter inserted. The work of Buchner and others on zymase has been dealt with, and a synoptic table of enzymes has been included.

A new edition of "The Imperial Gazetteer of India" is announced by the Oxford University Press. This may be considered as a new work rather than a new edition, and it will consist of twenty-six volumes, including a companion atlas. Apart from the historical volume and a few other chapters of the Indian Empire, the whole of this work has been written by officials in India under orders of the Indian Government, and every page has been submitted to the criticism of the several administrations or departments concerned.

OUR ASTRONOMICAL COLUMN

Comet 1907*b* (Mellish).—The following elements and ephemeris for comet 1907*b* have been computed by Messrs. Lamson and Frederick from places observed on April 15, 16, and 17:—

Elements.

$$T = 1907 \text{ March } 27.56 \text{ (G.M.T.)}$$

$$\left.\begin{aligned} \omega &= 328^\circ\ 47' \\ \Omega &= 189^\circ\ 7' \\ i &= 110^\circ\ 12' \end{aligned}\right\} 1907{\cdot}0$$

$$\log q = 0.924$$

Ephemeris 12h. Greenwich M.T.

1907	α (h. m.)	δ
April 22	7 46	+35 36
,, 26	8 4	+40 58
,, 30	8 17	+44 17

The brightness is decreasing rapidly from 0.59 on April 18 to 0.11 on April 30, the unit of brightness being that when the comet was first discovered (mag. 11·0). The comet is now circumpolar, and is travelling through the constellation of the Lynx in a north-easterly direction, towards Ursa Major (*Kiel Circular*, No. 96).

A New Variable or Nova 156.1906.—In the *Atti della Reale Accademia dei Lincei*, vol. xvi. (fifth series), p. 241 (March 3), Prof. E. Millosevich records the observations of a faint star which is certainly an interesting variable, and may prove to be a fading Nova. On November 6, 1906, the star in question was first noticed as a yellow object of magnitude 8.4, its position being

$$1906.0\ \alpha = 1\text{h. } 23\text{m. } 56.50\text{s.},\ \delta = +50^\circ\ 22'\ 12''.1$$

Subsequent observations showed that the star was fading, the decrease in brightness being roughly proportional to the time, and amounting to about 0.3 magnitude in ten days. By February 26, 1907, the magnitude had decreased to 12.3, the colour, in the interval, having passed through successive stages from yellow to red to quite a ruby-red, which was still notable on February 19, when the magnitude was but 12.0.

The Albedoes of the Superior Planets.—A novel method of calculating the albedoes of the superior planets is suggested by Mr. J. E. Gore in No. 382 of the *Observatory* (p. 172, April). The mass of the brighter component of α Centauri is equal to that of the sun, and their spectra are similar, thus the star may be considered as a duplicate of the sun, and Mr. Gore proposes to estimate the albedoes of the superior planets by comparing their photometric magnitudes when in opposition with that of α Centauri.

In a previous paper Mr. Gore has shown that, taking the parallax of the star to be 0″.75, and assuming the diameter of its brighter component to be the same as that of the sun, the apparent brightness of our central luminary is 75,232,650,000 times that of the brighter component of α Centauri.

Connecting this with the amount of sunlight inter-

cepted by the planet, the planet's mean distance and its photometric magnitude at opposition Mr Gore evolved a formula which gave the following values for the albedoes of the several planets:—Mars, 0·2072; Jupiter, 0·595; Saturn, 0·6744; Uranus, 0·61; and Neptune, 0·6276.

The Second Globular Cluster in Hercules, Messier 92.—No. 3, vol. viii., of the *Astronomiska Iakttagelser och Undersökningar å Stockholms Observatorium* is devoted to a discussion, by Dr. Karl Bohlin, of the measures of a plate showing the cluster Messier 92, taken at Stockholm on April 29, 1898. The conditions of measurement and the corrections applied are discussed in full, the actual measures being tabulated. The number of stars considered is three hundred and forty-eight, and of each of these the position and magnitude for 1898·0 are given. In a third table the resulting places are compared for twenty-nine stars, with those obtained from measures made at Upsala in 1873, and the apparent proper motions deduced. A diagram given at the end of the volume shows these proper motions graphically, the greatest differences (Stockholm-Upsala) being $\Delta\alpha=+6''.6$ and $\Delta\delta=-4''.6$, whilst the mean values are $+1''.5$ and $-1''.7$ respectively.

Halley's Comet.—*Knowledge and Scientific News* for March (No. 3, vol. iv., p. 57) contains an interesting article by Mr. F. W. Henkel on Halley's comet. Mr. Henkel discusses cometary phenomena and mechanics in general, showing their application in the observed appearances of Halley's famous object in particular. The apparitions are carried back as far as 1066, although the identity of the object represented on the Bayeux tapestry with that known as Halley's comet cannot yet be regarded as beyond doubt; probably the investigation now being carried out by Mr. Crommelin may settle this question. Many other interesting points, such as the perturbative action of Jupiter, the existence of an interplanetary resisting medium, and the various features presented by Halley's comet at previous apparitions, are dealt with in a very simple manner in Mr. Henkel's paper.

Eclipses of Jupiter's Satellites, 1878–1903.—The results of the photometric observations of the eclipses of Jupiter's satellites carried out at the Harvard College Observatory between June 23, 1878, and the end of 1903, are published by Prof. E. C. Pickering in part i., vol. lii., of the Annals of the Astronomical Observatory of Harvard College. The present publication contains simply the observational records in detail, with notes on the same, and a catalogue of the eclipses which were observed. The discussion of the entire material by Prof. R. A. Sampson, of Durham University, will appear in part ii. of the same volume.

RAINFALL IN GERMAN SOUTH-WEST AFRICA.[1]

In spite of native risings and recalcitrant Parliaments, our German cousins manage to carry on meteorological observations in their African possessions, and some results of their work which are of great importance in connection with the general meteorology of South Africa have just been issued as a supplement to the official "Deutsches Kolonialblatt." In the first section of this publication Dr. Ottweiler has collected and re-printed all trustworthy rainfall records—both official and unofficial—from German South West Africa, and, for the sake of completeness and comparison, he has added returns from a number of stations in the adjoining British and Portuguese territories. For this alone, meteorologists will be grateful to him. A supplementary table giving the positions and heights of the stations, and in most cases a brief description of the orographical features of the country surrounding them, will also be welcome.

As is to be expected in so "young" a country, the material collected is far from homogeneous, and, moreover, most of the stations are of very recent date. The author thus had before him the task of "weighting" the means deduced from the observations to render them approximately comparable among themselves before proceeding to discuss results. The process is not entirely satisfactory, but unless we are to refrain from drawing conclusions until a homogeneous body of statistics is available, some manipulation of the figures is necessary.

The results, which are illustrated in a number of admirable plates, are of exceptional interest, though they will be disappointing to those concerned with the economic development of the country. The coastal districts may be described as practically rainless, which is remarkable, as the prevailing winds are southerly or south-westerly throughout the year, and the land rises tolerably rapidly. In most parts of the world, sea breezes blowing on to rising land yield a copious rainfall, but on the coast of German South-west Africa the air is derived from higher and colder latitudes, and, as it blows over the cold Benguela current before it reaches the land, it contains little moisture when it commences its forced ascent. The heating effect of the sun far outweighs the dynamical cooling due to the ascent, and the condensation stage is never reached. Practically the only moisture which reaches the land near the coast is derived from the heavy fogs, which in winter are of almost daily occurrence. The winter rainfall, which is so prominent a feature in the west of Cape Colony, does not extend north of the Orange River.

In the more eastern inland districts the dry south-west wind prevails throughout the winter, and this portion of the year is accordingly rainless. In summer the wind shifts to the eastward, and a limited amount of moisture manages to reach the country from the Indian Ocean. In the neighbourhood of Windhuk the average annual rainfall is about 12 inches or 14 inches, and in the extreme north-east of the colony it exceeds 26 inches.

When the details of this fall are examined its value for economic purposes is found to be but small. Great fluctuations occur in the annual totals, which are of all the more importance, as the amounts are so small. Thus in the country round Windhuk the fall during the last twenty years has fluctuated between 47 per cent. and 210 per cent. of the average. Further to the south, conditions are considerably more unfavourable.

Great variability in the annual rainfall is not the only disadvantage from which the country suffers. Almost all the rain falls in thunderstorms, and torrential downpours are the rule rather than the exception. A single, though by no means isolated, instance will suffice to give an idea of the prevailing conditions. At Udabis in the year 1900 the total rainfall was 9·5 inches, and of this amount 6·5 inches fell in the course of three consecutive days, leaving only 3 inches to be distributed over the remaining 360 odd days.

It is interesting to compare the German results with those which have just been issued by the Governments of British East Africa and Uganda for the year 1905. In British East Africa the annual totals at thirty-three stations ranged from 16 inches to 99 inches. Only four stations experienced more than two absolutely rainless months, and in only two cases were these consecutive. A summary of totals for past years, which is appended to the report, shows considerable fluctuations in the amount. At three stations with records extending over at least eight years the totals fluctuate from about 40 per cent. to about 150 per cent. of the mean value for this period.

From Uganda rainfall data are given for nine stations. The totals for these varied from 37 inches to 96 inches. Only one station had an absolutely dry month. At Entebbe the year was the wettest on record. The total fall was 65·74 inches, 112 per cent. of the average for the last six years. Ten years' records (the first four incomplete) now exist for this station. During this period no absolutely dry months were experienced.

The British Empire has not yet produced a work on the meteorology of any of its possessions in tropical Africa which can be compared with that just issued in Germany, but it is gratifying to find that the Governments responsible for the administration of our share of the Dark Continent are realising the importance of meteorological observations, and of their systematic publication.

[1] Wissenschaftliche Beihefte zum deutschen Kolonialblatte, 20 Band, 1 Heft. Mitteilungen aus den deutschen Schutzgebieten. Die Niederschlagsverhältnisse von Deutsch Südwestafrika. By Dr. F. von Danckelman. Pp. 84. (Berlin: S. Mittler und Sohn, 1907.)

THE RIVER PILCOMAYO[1]

THE river Pilcomayo has its source in the Bolivian mountain ranges, and traverses the virgin forests of the Gran Chaco in a south-easterly direction. For nearly two hundred years the idea of utilising this river for purposes of navigation has engaged the attention of the Governments of Argentina, Bolivia, and Paraguay, in order to provide the rich regions through which it passes with an easy means of communication, and to afford an outlet by water for the natural products of the fertile zones of the eastern part of Bolivia.

The author of the report before us, who is a member of the American Society of Engineers, was appointed by a syndicate of capitalists in 1905 to conduct an expedition for the purpose of studying the navigable condition of the river, and reporting as to the possibility of rendering it fit for the passage of boats.

The exploration party consisted, besides the chief, of two assistants, a land and forest expert, storekeeper, and twenty-five men. They took with them for the purposes of transport twenty-two mules, forty-one horses, sixteen oxen and five boats. Twenty-two bullocks were also taken for food. The expedition occupied four months.

The country traversed appears to be sparsely inhabited by Indians who on the whole are friendly. A colony has been established at Buena Ventura, about 560 miles up the river, which contains thirty families of colonists, with a total population, including servants, "intruders," and squatters of 1000 souls. There are also in the district some Roman Catholic mission stations.

The river Pilcomayo discharges into the Paraguay, the depth at low water at its junctions being about 10 feet, and above this for sixty miles there are no soundings less than 10½ feet. At 120 miles the depth decreases to about 7 feet; at 150 miles there was barely 3 feet. At about 317 miles from its mouth the river is lost for ten miles in a marshy tract of country, through which there does not exist any defined channel. Beyond this tract, which constitutes an immense horizontal plane extending to "distances unknown" at 327 miles from the mouth the river again assumes a defined channel with a depth of from 10 feet to 12 feet. This channel was explored up to the Argentine boundary at El Hito 677 miles from the mouth. The width varies from 100 feet at the lower end where the course is well defined, to 300 feet in the upper part.

In the lower part of the river the water is brackish and unfit to drink, owing to a number of salt springs, and in the upper river it is turbid and of a reddish colour.

To render this river navigable for barges carrying twenty-five tons and drawing 4½ feet of water, over a length of 670 miles, or about 100 miles beyond the colony of Buena Ventura, the commission advised the construction of three cuts or canals, one to avoid the marshy district and the two others two porous districts in the upper length; these cuts to have a bottom width of 33 feet with 5 feet depth of water, the construction of seventy-three locks and dams, the regulation of the channel and clearance of obstructions. The amount required to carry out these works is estimated at a sum equal to about one million of English money.

CRETACEOUS FERNS[2]

THE author states that he approached the subject of palæobotany as a layman whose earlier training had been mainly in physics and mathematics. He set himself to collect such fragmentary remains of fossil plants as the Lower Cretaceous rocks of his neighbourhood afforded, with the intention of making an intensive study of the several genera. This first instalment of his results deals mainly with a single genus of Mesozoic ferns, to which Dunker in 1846 gave the name Hausmannia. The fronds of this genus are characterised, in some species, by the possession of a bi-lobed lamina not unlike that of the leaves of the maiden hair tree (*Ginkgo biloba*), while in other forms the lamina is divided into several linear lobes, and bears a resemblance to the leaves of Baiera, an extinct genus of the Ginkgoales. It is, however, with the recent Indian and Malayan fern Dipteris that Hausmannia exhibits a more than superficial resemblance. Despite the unfavourable nature of the Quedlinburg rocks from the point of view of preservation of detail, Prof. Richter's industry has been rewarded by an accumulation of material which has enabled him to add considerably to our knowledge of this well-defined genus of ferns. He has instituted, on what appear to be adequate grounds, a few new species. The flora of Quedlinburg is characterised by a preponderance of ferns, which are said to form 80 per cent. of the whole; no trace of Angiosperms has been found; Conifers and Cycads are rare, while ferns are represented by the Gleicheniaceæ, Matonidium, Laccopteris, Clathropteris, Hausmannia, Weichselia, and a few fragments of the common Wealden species *Onychiopsis Mantelli*. It would seem that in these fossils we have the relics of a vegetation which flourished in a situation favourable to ferns. Ferns undoubtedly played a more prominent part in the composition of Mesozoic floras than in the floras of the present, but it is unlikely that the Quedlinburg flora as a whole was composed almost entirely of these plants to the exclusion of Lower Cretaceous Gymnosperms which are recorded from other localities.

Prof. Richter's contribution does not throw any fresh light on the nature of the sporangia of Hausmannia; he has, however, demonstrated a striking resemblance in habit to recent species of Dipteris as regards the slender rhizomes and long leaf stalks. The author is disposed to regard the affinity between this northern Lower Cretaceous type and the Malayan Dipteris as rather less close than has been assumed by Prof. Zeiller and by the reviewer. In the absence of well-preserved sporangia the question of degree of relationship cannot be settled, but the account given of such fragments of fossil ferns as were accessible to the author of this monograph seems to strengthen the view that the Dipteridinæ were abundantly represented in the northern hemisphere in the latter half of the Mesozoic era. In age the flora is considered to be rather younger than Wealden, and is compared with the Urgonian flora of Greenland as described by Heer. It is difficult to draw a conclusion as to geological age from the small number of types so far described, but in our opinion the Quedlinburg plants might fairly be classed with the Wealden floras of northern Germany, England, Belgium and many other regions.

Prof. Richter has done good service to palæobotany by his thorough and scientific researches, and one may express a hope that other amateurs may follow his example and devote themselves with equal energy and success to the detailed study of the fossils of a single district.

A. C. S.

PROBLEMS OF APPLIED CHEMISTRY[1]

THE science and art of the engineer are intimately interlaced with those of the practical chemist. The practical, as distinguished from the scientific, chemist possesses sufficient knowledge and experience to see to the working of machines and to minor repairs without calling in an engineer, save in difficult or complicated cases. In former times the chemical manufacturer learned his trade both on the chemical and the engineering side, as far as it was indispensable, but he learned it simply "by rote," as the saying goes. To be sure, this never took place without large sums of money being thrown away, either in the form of misshapen or faulty apparatus and machinery, or of spoilt chemicals, and so on. And this happened to the unstudied "practical man" who through family connections or by mere chance, had stumbled into chemical manufacturing, as well as to men who had studied the science of chemistry and who desired to apply the knowledge thus gained to the execution of some well-known process or to the working of some laboratory in-

1 "The River Pilcomayo from its Discharge to Parallel 22 S., with Maps of Reference." By Gunnar Lange. Pp. 124. Translated from the Argentine Original. (Buenos Aires: The Meteorological Office Press, 1906.)

2 "Beiträge zur Flora der unteren Kreide Quedlinburgs. Teil I., Die Gattung Hausmannia, Dunker, und einige seltenere Pflanzenreste." By Prof. P. B. Richter. Pp. iv+27+plates. (Leipzig: W. Engelmann, 1906.)

1 Abridged from a discourse delivered at the Royal Institution on Friday, March 15, by Prof. George Lunge, of Zurich.

vention on a large scale Those men who possessed a scientific foundation were, in their turn, compelled to learn the technical side of their profession by dint of practice, just as the tailor has to learn the art of making clothes and the barber the art of shaving A man of scientific attainments had certainly, even in the olden times, a clear advantage over the mere "practical man"

But many branches of manufacturing, which undoubtedly have a chemical basis, and in which to-day a large number of chemists are actually employed, were formerly carried on in a purely empirical manner like any handicraft, for instance, soap-making, tanning, brewing—indeed, all those industries which are connected with food—and above all, dyeing and tissue-printing But towards the middle of the last century we perceive the commencement of a scientific treatment of those industries Even before then, the genius of Chevreul had thrown a flood of light on the chemical behaviour of fatty substances and Persoz followed in the domain of dyeing fabrics The cooperation of the various arts and sciences was distinctly promoted by the technical high schools in France, Germany, and Switzerland

In Great Britain the chemical industries had from the first taken their full share in the astounding development of all branches of industry which in this country has for several centuries enjoyed an uninterrupted peace, whilst continental Europe was lacerated by frequent wars Thus Great Britain had a long lead in all the fields of commerce and industry

Some of the most important of the chemical industries have, indeed, altogether *originated* in this country, especially that of sulphuric acid and that of chloride of lime, both of which date back as far as the eighteenth century, But it is only fair to remember that some of the most important improvements in these manufactures are due to French inventors and French men of science To France we owe the invention of the Leblanc process, which could not be at once introduced into this country, owing to the fact that common salt was burdened with an absolutely prohibitive excise duty The abolition of this tax in 1823 acted like the wave of a magic wand, not merely in calling into life the manufacture of alkali itself, but by giving a strong impetus to all the chemical industries connected therewith, viz those of sulphuric, hydrochloric, and nitric acid Almost immediately the tide of inventions and improvements set in, and a few decades later we find Great Britain absolutely dominant, not merely in the branches just mentioned, but generally in the field of inorganic chemical industries For many years up to 1870 about, this predominance was not seriously called into question

In this manner inorganic chemical industry was developed in Great Britain up to the middle of last century to a greater extent than in any other country, by men like the Muspratts, Tennant, Gossage Dunlop, Chance, and many others Most of them were neither studied chemists nor engineers, but in their school any theoretically educated chemist could immensely profit for the work of factory-manager

In close connection with this state of matters we find in England among the greatest inventors men who, at the outset, did not even possess a routine knowledge of the field in which they achieved their later successes, and who were altogether "outside the profession," like Walter Weldon Henry Bessemer, Sydney Gilchrist Thomas

Peculiar to England is also the case of William Henry Perkin who, at the early age of sixteen, entered Hofmann's laboratory in London Two years afterwards he discovered the colouring matter called "mauve," the forerunner of all colours produced from coal-tar, and only a year later he built a factory for producing his mauve, which at once proved a success and laid the foundation for his splendid work in after life

One of the great problems presented to applied chemistry in the last century, at which many inventors in all industrial countries have been working, was the utilisation of "alkali-waste" The first partial success in this direction was scored in 1861 by Ludwig Mond and by Max Schaffner. One of the first patents referring to it was taken out in 1837 by Gossage He quite rightly recognised a number of the conditions necessary for realising that reaction, but, unfortunately, not all of them It soon became manifest that there were unforeseen difficulties not yet overcome The missing links in the process were only discovered in 1883 and 1887, and led to the application of that process at all the Leblanc works This final success is connected with the names of Carl Friedrich Claus and of Alexander Chance

Many German chemists (as well as the speaker himself) at that time came to England for their practical education, for instance, Caro, Pauli, Martius, Peter Griess, and Ludwig Mond The two last-named have permanently associated themselves with this country, whilst the three first-named, as well as many other German chemists who had found a temporary home in England, returned later on to their own country, and these very men have been in the forefront of those to whom is due the remarkable development of German chemical industry.

Formerly the German professor, as well as his students, had been frequently held up to ridicule, not merely abroad, but at home as well, as idealistic dreamers, unsuited to the wants of real life and to the requirements of trade and manufacture, and in this there was only too much truth, so long as they were not in intimate touch with men of practice But at last an amalgamation between these two classes of men took place Within a very few years there arose those enormous establishments at Ludwigshafen, Hochst, Elberfeld, Berlin, Darmstadt, and elsewhere, which are conducted on a scientific basis, but with the most extensive utilisation of all the attainments of manufacturing experience Austria, France, Switzerland, Belgium, and America have all made immense strides in that direction. And what of Great Britain? Seeing that in pure science the people of Great Britain have never lagged behind *any* other nation, and that, on the contrary, the land of Newton and Faraday has been a beacon to all others at more than one epoch, there is absolutely no valid reason why she should now, or at any other time, be behind any other in the combination of science with practice

The history of the ammonia-soda process has been directly contrary to so many others It was invented by two Englishmen, Dyar and Hemming, in 1838, who did not succeed in the *practical* application of their invention, nor did their numerous successors meet with any better fortune A Belgian engineer, Ernest Solvay, found the first economical solution of that problem, and the economical superiority of the ammonia over the Leblanc process soon became evident This was brought home to English manufacturers by the success of the firm of Brunner, Mond and Co The Leblanc process, and the enormous sums of money invested in it, seemed even then doomed to speedy extinction But for a time, at least, this calamity was averted by the perseverance with which the British alkali makers kept making improvements in the Leblanc process The prolongation of its life is due to the fact that in the first stage of the process an important acid is produced, which is not furnished by the ammonia process, viz hydrochloric acid Most of this is immediately converted into chlorine, which gas is used up for preparing bleaching powder, bleach liquors, and chlorates Of these, bleaching powder is a British invention made by the Glasgow chemist, Tennant, but, apart from this, the manufacture of chlorine and of all chlorine products has been put on its practical basis almost entirely by English inventors, and has been developed more extensively in this country than anywhere else in the world But this last entrenchment of the Leblanc process is being vigorously assaulted from another quarter—by the electrolytic processes, which split up the alkaline chlorides directly, and in the simplest possible manner, into free chlorine and caustic alkali

Even now it is only quite exceptional that, wherever the electrical current has to be produced by means of *steam*, electrochemical methods can compete with the older ones for the manufacture of what is called "heavy chemicals" Just those two European countries which are the greatest producers of coal, Great Britain and Germany, are less favoured by nature in respect of water-power than other countries which possess little or no stores of mineral fuel, as Sweden, Norway, Switzerland, France, Italy, and Spain A very different condition of affairs

obtains in the United States, where we find the greatest coalfields combined with the greatest amount of water-power existing in any civilised country. The day will inevitably come when the coalfields will be so far exhausted that all those industries which consume large amounts of mechanical energy will be forced to emigrate to countries where water-power is abundant.

No other substitute has, as yet, been found for generating force, and, indirectly, electricity.

Even in those countries which are more favoured, the amount of water-power is by no means infinite, and, if it had to be drawn upon, not merely for motive purposes, but for the production of electricity for heating purposes, it would be found insufficient in most places. Here we are faced by one of the greatest problems of applied science, both in chemistry and in physics, a problem which will give plenty of occupation to generations of future inventors. At present we can only surmise that some solution will present itself in the shape of a direct conversion of the sun's rays into other forms of energy, but the means by which this would be *practically accomplished* are at present quite uncertain.

Seeing that the stock of mineral fuel upon this earth is so very limited, cannot we find means of husbanding it more than this has been done hitherto? Of the energy residing in coal most ordinary steam-engines utilise less than 10 per cent., and even the most perfect steam-engines hardly more than 15 per cent. The conversion of pig iron into steel, the manufacture of glass, and many other industries consume from four to twenty times and even more the quantity of coal required by theory. Moreover in burning our fuel whether it be for industrial or for technical purposes we invariably send its nitrogen into the atmosphere, which surely contains quite enough of that commodity, the only exception being the manufacture of coal-gas. Here some of the grandest problems of applied chemistry present themselves to us—how to stop that fearful waste of fuel and how to recover the nitrogen of the coal, if that be possible.

It is certain that we must look for the solution of these questions in the direction of converting coal into gaseous fuel. Another great stride ahead lies in the better utilisation of the waste gases from blast furnaces, in which respect the last few years have witnessed some very important improvements. All this refers merely to a better utilisation of the heating power of coal, but not to that other great task, the recovery of its nitrogen in a useful shape.

The immense importance of the problem lies in the fact that it touches our most urgent want, our supply of food. For agricultural purposes it does not make much difference whether we apply the nitrogen in the form of ammonia or of nitrates. The ammonia, apart from insignificant quantities otherwise obtained, all comes from the nitrogen of the coal, but up to about twenty years ago only that coal which was used in the manufacture of gas was made to yield ammonia, and only one-sixth of its nitrogen was obtained in this form. In the manufacture of coke, which is also a process of destructive distillation and entirely analogous to gas making, very much larger quantities of coal are consumed. Up to about twenty years ago all the volatile by-products in the manufacture of coke were lost—that is to say, tar, gas, and ammonia. Even now both in France and England, as well as in America, the recovery coke-ovens have found only a very limited adoption. In England perhaps 5 per cent. of the coke is made in this way against upwards of 50 per cent. in Germany.

But that reserve is, after all, nothing like sufficient to cover the requirements of agriculture in the future, and it is quite likely that in the long run all the really available nitrogen of the coal would not suffice for the wants of man. And what about the time when coal itself will be exhausted? Well, there is an eternal and inexhaustible source of nitrogen in the atmospheric air. Four-fifths of *this consists of nitrogen, calculated to amount to* 4000 billions of tons. But until a very few years ago the problem of turning the atmospheric nitrogen into ammonia or nitric acid, although frequently approached in a purely scientific or, experimentally, in a technical way, had not been solved. Our days have seen the realisation of that most important task.

Let us first speak of ammonia. We must start from calcium carbide. Prof. Adolf Frank and Dr. Caro, of Berlin, found that when nitrogen is passed over red-hot calcium carbide it is absorbed with formation of calcium cyanamide. This latter, when treated with water under high pressure, is made to yield ammonia; but it is not necessary to do this, since the crude product, which they have called "lime-nitrogen," can serve directly as nitrogenous fertiliser, and is in that respect equivalent to its own weight of ammonium sulphate. The works already in operation, or in course of construction, will by the end of this year utilise water-power to the extent of some 55,000 horse-power, and will produce lime-nitrogen equivalent to 100,000 tons of nitrate of soda.

Important as ammonia is as a fertiliser it ranks after the nitrates in that respect, and, unlike ammonia, the nitrogen of the nitrates is of immense importance for other purposes as well, viz. the manufacture of nitric acid and of explosives. These have, up to the present, been prepared almost exclusively from Chilian saltpetre. What, then, shall we do when the *nitre beds of Chili are exhausted?* an event which, according to most estimates, is bound to take place within thirty or forty years from now. Unfortunately, there is no tangible hope of similar beds being found in any other localities, certainly not to any great extent. The solution of *this* problem, if not altogether settled in its final shape, has now been found by means of that well-nigh omnipotent agent, electricity. At Notodden in the Norwegian Hitterdal a factory has been established to carry out the process of Birkeland and Eyde, who, by an ingenious application of the extreme heat produced by the electric current, make the nitrogen and oxygen of air combine to form nitric oxide, which at a lower temperature is spontaneously oxidised into nitrous vapours, with the ultimate production of nitrites or nitrates. This time there is really no doubt that a practicable and economical process has been discovered, for which it is intended to employ by the end of this year water-power to the extent of 30,000 horse-power. The Notodden process bids fair to be followed by other even more efficient processes. The most important of these is that of the Badische Anilin und Soda-Fabrik, for which an experimental factory is in course of construction, and for which 50,000 horse-power are to be employed.

Electricity has often been invoked to produce the most important of all inorganic products, iron. If this problem could ever be solved in an economical way it would bring about a perfect revolution in the position of the leading nations. On the one hand, the enormous quantity of coal now consumed in the production of iron and steel (which is probably at least a quarter of the entire output of coal) would be set free for other uses, and the exhaustion of the coal-fields would be put off to a corresponding extent. On the other hand, the production of iron would pass over into the hands of those nations which command the largest amount of water-power, and which, therefore, can *produce electricity most cheaply*. Of the three countries which now produce between them the bulk, that is, seven-eighths, of the world's iron, Great Britain and Germany would go to the wall, and the United States, which already produce more iron than these two countries put together, would become omnipotent in that field.

One of the problems belonging to the domain of organic chemistry is the substitution of artificial for natural colouring matters. This, indeed, has now been carried out almost to the bitter end. Long ago, one of the oldest and most widely used colouring matters, that contained in madder, succumbed to the attacks of the chemists, among whom the names of Edward Schunck and William Henry Perkin testify to the glorious share taken by Englishmen in that victory. The colouring substance of madder—alizarin—is now made from English coal-tar, and has altogether taken the place of the impure form in which it occurs in the madder plant. The growers of this plant in the south of France and elsewhere have had to abandon its culture altogether, to their great sorrow.

A similar fate has already partly overtaken, and may, in the end, destroy entirely the culture of indigo. Synthetic indigotin is now manufactured at such a low price that its competition has proved a severe blow to the indigo-planting interests. Thus the triumph of scientific investi-

gation and practical skill in chemical manufacturing, gratifying though it be as a splendid achievement of applied chemistry, is a sad trial to many thousands of Indian ryots and their British masters, and this is merely the foretaste of what will inevitably happen in many other cases. What is food for one is poison for another.

Perhaps the very greatest problem of applied chemistry is the direct production of feeding-stuffs for man and beast. The synthesis of alimentary substances from inorganic matter has up to this moment, not been even remotely achieved, nor can we at present so much as guess the direction in which this might be done whilst, as for the production of food from sawdust and other waste organic substances we are in no better case. But even here the word "impossible" should not be pronounced. In a more modest form at all events chemistry has found magnificent scope in that quarter, viz. in the extraction of alimentary substances from new sources and in the increase of production from old ones. The colossal industry of beet root sugar is an instance of the former whilst agricultural chemistry, as a whole works in the latter direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

COURSES of lectures, and arrangements for informal instruction have been arranged by the Oxford University Committee for Anthropology for the coming Easter term. There will be lectures and other instruction in general anthropology, physical anthropology psychology, geographical distribution, prehistoric archæology, technology, sociology (religion, law custom &c), philology, and other subjects of interest to students of anthropology.

THE sum of 6100*l* has been subscribed by alumni of Harvard University to establish a Shaler memorial fund in commemoration of the long services of Prof. N. S. Shaler and of the great affection in which he was held by his many students and friends. It is proposed to place a memorial tablet in the geological section of the University museum or some other suitable place, and to use the income of the balance for the benefit of the division of geology in support of original research and in the publication of the results of research.

ON Tuesday April 23, the Prince and Princess of Wales visited Glasgow and opened the new buildings at the University. These buildings were erected by Principal Story's university fund, which was largely raised by the efforts of the late Principal. They form an important addition to the laboratory and lecture room equipment of the University. They consist of two large detached institutes to the west of the main building, one provides accommodation for the departments of physiology materia medica, forensic medicine, and the other for the department of natural philosophy. The cost of the buildings has been defrayed by subscriptions to the amount of 80,000*l* from the citizens of Glasgow and a grant of 40,000*l* from the Carnegie trustees. A special honorary graduation was held on the same day, at which the honorary degree of LL.D. was conferred on the Prince and Princess of Wales, the Lord Provost of Glasgow (Mr. Wm. Bilsland), the Duchess of Montrose, the Chancellor of the Exchequer, who is also Rector of the University, Right Hon. Geo. Wyndham a former Rector, Mr. Ure the Solicitor-General for Scotland, Sir George Watt, Sir W. R. Copland, Miss Galloway, Prof. Emile Boutroux, Prof. Norman Collie, Prof. J. H. Poincaré, Mr. Sidney Lee, Mr. D. S. MacColl, Mr. Jas. A. Reid, Mr. N. Dunlop, Prof. J. G. McKendrick, Prof. G. G. Ramsay, Prof. A. M. Stuart, and Principal Donald Macalister.

ON Saturday last, April 20, the Borough Polytechnic Institute was open for the annual inspection and display of students' work. To judge from the crowds which thronged through the building during the evening, those who live in the neighbourhood must take a great interest in this educational centre. In the chemical laboratory there was an exhibition of electrochemical apparatus and one saw the rapid deposition of metals by means of rotating electrodes. Apparatus for measuring the absorption taking place in reduction and oxidation methods was also shown working. In the general laboratory various chemical operations were in progress, such as fractionation, steam distillation, and the like. The general public who crowded the laboratories did not, of course, understand much, but they realised that what was to them mystical chemistry might be interesting, and perhaps a few of them will become students. The recently equipped electrotechnical department, which is in the engine-room, caused a good deal of interest. Many of the fittings have been put up by the students, who also helped to build up the experimental dynamo. The engineering department is becoming very complete, and students can now carry out tests upon quite a large scale. The latest addition here is a De Laval 5 horse-power steam-turbine engine coupled on to a dynamo. Some of the metal work and wood work executed by the students was of a very creditable character, the hammered copper work being especially interesting. A noteworthy exhibit was a vernier with micrometer screw which had been entirely made—scale and all—by a lad sixteen years of age in the technical day school. The average person who passed through the institute on Saturday night would probably be most interested in the bakery and confectionery department or in the book binding or shoe-making. All these, of course, are of great importance, and much good work is being done, but it should not be forgotten that on the scientific side which tends above all things to the nation's advancement, good work is being done with a rather difficult material and a small staff, the chemistry department being one of the very few in Great Britain which publishes research work.

THE question of education in relation to the British Empire was considered at a meeting held in the Guildhall London on Tuesday, under the presidency of the Lord Mayor. The following resolutions were unanimously adopted:—(1) That in the opinion of this meeting of citizens of London and others, the education of the people of Great Britain on the subject of the Empire is deplorably backward and that as an illustration of this fact it may be pointed out that no official map or text-book in regard to the Empire is available for teachers and the public; that in the opinion of this meeting the teaching of Empire subjects with the aid of official maps and text-books should be obligatory in all elementary and secondary schools in Great Britain and that the Government be requested to lend official assistance in the preparation of such maps and text books, and to sanction the permanent display of Empire maps in all schools post-offices, and public buildings (moved by the Duke of Somerset and seconded by Dr. Parkin). (2) That a public subscription for the purpose of Empire education be inaugurated, and that the aid of the London and provincial Press and of all societies and associations without regard to party politics be invoked to collect funds for the purpose; that copies of these resolutions be sent to the Government, all lieutenants of counties, lord mayors, and mayors throughout the country, inviting them to call public meetings and submit thereto similar resolutions, and appeal for subscriptions to the fund (moved by Lord Milner and seconded by Mr. Deakin). (3) That the fund be called the "Empire Education Fund," and that the first trustees shall be the Right Hon. Sir W. Treloar Lord Mayor, his Grace the Duke of Somerset, the Right Hon. Viscount Milner, P.C., G.C.B., G.C.M.G., the Right Hon. Sir Rowland Blennerhassett, Bart., P.C., and Mr. Allen H. P. Stoneham (moved by Lord Strathcona and seconded by Lord Ranfurly).

A CONFERENCE on the teaching of hygiene and temperance in the universities and schools of the British Empire was held in London on Tuesday. Lord Strathcona presided at the morning session and Sir John Gorst occupied the chair at the afternoon meeting. From the papers read it is clear that in several of our colonies and in some foreign countries much more attention is given to instruction in the laws of health than has yet been granted to it in this country. The chief object of the conference was to give prominence to this fact and to urge upon our educational authorities the importance of remedying the defect. Sir Victor Horsley, F.R.S., in an address on the method of introducing hygiene and temperance into secondary schools and universities, suggested that an

essential reform within the Board of Education is that there shall be such advice given to the Minister of Education as will enable him to grasp the principles of scientific education It is the business of the State to see that the code and curriculum of education are arranged on a scientific and common-sense basis, and this will necessarily include the hygiene of common life and instruction in temperance Sir Victor Horsley contended that we shall not make any headway unless we have expert advice at headquarters It is clear that the whole system of education requires revision from a medico-scientific standpoint The following resolutions were unanimously adopted —(1) "That this conference has heard with great satisfaction that instruction in hygiene and temperance is systematically given in the elementary schools of the colonies of the Empire, and that there is strong evidence of the value of this teaching While cordially acknowledging what has been already accomplished in the United Kingdom by certain educational bodies, this conference urges upon all local authorities the necessity of providing that the teaching of hygiene and temperance shall form an essential part of the whole curriculum of education of all children" (2) "This conference is of opinion that to meet adequately the responsibilities of the State towards school children it is essential that a medical department should be instituted in the Board of Education"

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 7—"On the Combining Properties of the Opsonin of an Immune Serum" By Prof Robert **Muir** and W B M **Martin** Communicated by Dr C J Martin, F R S

(1) The thermolabile opsonin of a normal serum and the thermostable opsonin of an immune serum are two distinct classes of substances In addition to differing markedly as regards their resistance to heat, they differ in their combining relationships

(2) The thermostable opsonin of the anti serum investigated is a true anti substance and possesses the comparatively specific characters of anti-substances in general, it is left undetermined whether it has the constitution of an agglutinin or of an immune body, though certain facts point in favour of the former

(3) Emulsions of other organisms other than the organism used in immunisation (*Staphylococcus aureus*) do not absorb the immune opsonin, on the other hand, they absorb large amounts of the normal complement like opsonin

(4) Powerful complement-absorbers—red corpuscles or bacteria treated with immune body or serum precipitate—have no effect on the thermostable immune opsonin whereas they remove almost completely the labile opsonin of the normal and the immune serum alike

Faraday Society, March 10—Dr T Martin Lowry in the chair—The potential of hydrogen liberated from metallic surfaces H **Nutton** and H D **Law** The paper is chiefly concerned with the chemical reducing power of hydrogen when liberated from the surface of various metallic electrodes, and also the retarding action caused by the presence of small quantities of metallic salts The metals are arranged in the following order—mercury, lead, cadmium, tin, silver bismuth gold nickel, platinum (black), the first mentioned metal being the most capable of bringing about the reduction of a compound not readily attacked, platinised platinum, on the other hand, possesses this property in the lowest degree Zinc as a reducer behaves in a very irregular manner, both copper and platinum (black) show a remarkable activity in the reduction of aromatic aldehydes, and iron and aluminium are variable It was hoped by a careful study of the electrode potentials that it might be possible to differentiate between the purely chemical changes and those which were due to physical causes—Electrode potentials in liquid ammonia N T M **Wilsmore** and F M G **Johnson** The measurements of electrode potentials in liquid ammonia were undertaken with a view to the determination of the free energy of formation of a series of metallic salts, and thereby to compare the relative affinities of the corresponding metallic elements under conditions differing as much as possible from those obtaining in the case of measurements in aqueous salutions To this end the electrode potentials of the metals against solutions of their salts of known strength were measured against a standard electrode (cadmium in a saturated solution of cadmium nitrate) The results are given in the paper in tabular form—The impedance of solutes in solvents as manifested by osmotic pressure J G A **Rhodin** The author's object is to substitute for the theory of van 't Hoff, the main objection to which, in his opinion, is the direction of pressure a theory which regards the solvent—and not the solute—as the source of the energy manifested in osmotic pressure experiments—The electrolytic deposition of zinc, using rotating electrodes, part ii Dr F Slater **Price** The effect of the addition of various electrolytes on the electrolytic deposition of zinc, using a rotating kathode and the apparatus described in the previous paper, has been investigated In all the experiments the kathode was silvered before the zinc was deposited Excellent results were obtained using 2 grams of sodium sulphate and 1 gram of sodium acetate for each gram of crystallised zinc sulphate, the addition of free acetic acid being unnecessary The number of revolutions per minute of the kathode was 600–700, and the time of deposition was fourteen minutes

Linnean Society, March 21—Prof W A Herdman, F R S, president, in the chair—The origin of Angiosperms E A Newell **Arber** and John **Parkin.** In attempting to trace the ancestry of this group the authors commence by a survey of living Angiosperms with a view to determine which among them present primitive features and also with the hope of arriving at some hypothesis as to the type of fructification possessed by the earliest members of the group They dissent emphatically from the view generally held and especially advocated by Engler that the most primitive Angiosperms to-day are those with unisexual flowers and without perianth e g Piperales Pandanales &c This conclusion is criticised on the grounds that (1) the perianth must be assumed to arise *de novo* and to be an organ *sui generis*, (2) such plants have a sharply defined and highly complicated inflorescence, which can hardly be regarded as primitive (3) it has so far proved barren from a phylogenetic standpoint On the contrary they urge the acceptance of a strobiloid theory of the angiospermous fructification on the grounds that it is typically and primitively a diplosporangiate (hermaphrodite) cone with a well marked perianth and one in which all the organs were originally numerous, spirally arranged, and hypogynous It is pointed out that some of these primitive features are still retained among members of the Magnoliaceæ, Ranunculaceæ Alismaceæ &c From such a cone the authors would derive by reduction the apetalous unisexual flowers The flower is recognised as a special type of strobilus to which the name Anthostrobilus is given and of which two forms can be distinguished, the one gymnospermic, the other angiospermic Both, however, are essentially of similar construction especially as regards the peculiar juxtaposition of the micro- and mega sporophylls and the presence of a perianth The view is expressed that the "motive force" which called the Angiosperms into existence, was a radical change in the method of pollination

Physical Society, March 22—Prof J Perry, F R S, president, in the chair—Experimental mathematics Mr **Pochin** An instrument for describing logarithmic spirals was exhibited and it was shown how the principal properties of logarithms and of the equiangular spiral may be established as experimental results A spiral was described with an angle of 45°, and the positions of the radius vector, representing the first ten natural numbers, were drawn in Cardboard sectors having been cut to fit the various angles under the successive positions of the radius vector, it was shown that these sectors represented the logarithms of the numbers Multiplication and division were illustrated by placing the sectors in juxtaposition, so that the angles were added or subtracted, the result being read off directly from the curve A table of natural logarithms was also prepared from the spiral, by direct

measurement with a foot-rule and a protractor graduated in radians. A geometrical analysis was given, confirming the accuracy of the experimental results, and affording an independent proof of the exponential theorem. A second spiral was drawn with an angle $\tan^{-1}M$, thus giving common logs. in terms of the radian, and it was shown that, by using a suitably graduated protractor or modulus, one system transformed into the other. A Boucher's circle and a slide-rule were also derived practically from the spiral. The differentials $d\log_e r/dr$ and $d\log_{10} r/dr$ were shown graphically, as well as the properties of the evolute and involute.—Logarithmic lazy-tongs and lattice-works: T. H. **Blakesley.** If two straight rods, AB, CD are jointed at E, and so related that the extremities ACBD lie in the circumference of a circle, they will fulfil this condition when the angle between is changed. Suppose that AE is taken as unity, and that ED=n, EC=m, m and n being quite independent. Then EB=mn as a consequence. If another pair of rods, DF, BG, similar to the first pair but bearing the ratio n : 1 to it, be jointed at D and B to the first pair, and to the extremities FG of this pair a third pair be again jointed, and a fourth to this and so on, the ratio of each pair to the preceding one being n : 1, the resulting linkage is called by the author a logarithmic lazy-tongs. A lazy-tongs constructed as above is said to be in the n direction. Any of the four sides AC, CB, BD, AD might be chosen as that to which the next pair of rods is to be attached, care being taken to make the ratio correspond to the direction chosen. If CB is chosen the ratio must be m : 1, and a lazy-tongs in the direction m will result, the angular shift at each step being EAD—EDA. Suppose pairs added in the m direction to both CB and BF, then these two pairs will have, in addition to B, another common point, viz. that which is homologous to B in the m direction. In fact, the same pair is arrived at whether by moving once in the n direction and then once in the m direction, or *vice versâ*. It is clear that a joint may be added at the common point and that the rule is a general one, hence all plane space may be occupied by such a linkage, which is called a logarithmic lattice-work. Such a lattice-work moves so that the angles at E, and points homologous will remain equal.

Geological Society, March 27.—Sir Archibald Geikie, Sec.R.S., president, in the chair.—The southern origin attributed to the northern zone in the Savoy and Swiss Alps: Prof. T. G. **Bonney.** Prof. Lugeon, with some other eminent Continental geologists, explains certain peculiar flat folds the higher of which sometimes project considerably beyond the lower, in the more northern sedimentary zone of the Swiss and Savoy Alps, by supposing that to no small extent the strata have been thrust forward from an original position south of the watershed of the Pennine-Lepontine Alps, overriding, as they advanced, their crest and that of the Oberland (neither having then attained its present altitude). This pressure was produced by the greater thickness of deposits of mid-Tertiary age, speaking in general terms. Prof. Sollas, in concluding a very interesting and suggestive paper on some experiments with cobbler's wax, published in the last volume of the Quarterly Journal of the society, p. 716, suggests that the results are favourable to the views of the Lausanne professor. The author takes exception to some of the cases, especially two to the east of the Simplon Pass, which are adduced by Prof. Lugeon in support of his hypothesis. It is maintained that the hypothesis receives no real support from Prof. Sollas's experiments, and involves mechanical difficulties which are practically insuperable.—The coral-rocks of Barbados: Prof. J. B. **Harrison.** The results of the author's extended, and in many places detailed, re-examination of the coral-rocks in the southern half of Barbados give no support to Dr. J. W. Spencer's theory of the existence of strata of the "Antigua formation" in that island. It is now shown that a certain knoll, whence Dr. Spencer collected corals which in his estimation proved that it and other parts of the coral-rocks were of Oligocene age, is in part made up of corals which, as stated by Prof. J. W. Gregory, "certainly show no evidence of any age greater than the Pleistocene." The author has failed to find any signs of the widespread formation, described in Dr. Spencer's paper as extending from Mount Misery to near Ragged Point, a distance of about eleven miles, and dipping south-eastward at from 12° to 20°.

Society of Chemical Industry, April 8.—Mr. R. J. Friswell in the chair.—Observations on cotton and nitrated cotton: H. **de Mosenthal.** This paper deals with the appearance of celluloses and nitrocelluloses in polarised light, their refractive indices and optical activity, as well as densities. Fourteen samples of nitrated cottons of different degrees of nitration, different solubility and viscosity, three samples of nitrated wood cellulose, and two each of nitrated ramie and flax, were examined. The appearance in polarised light was found to vary with the degree of magnification and the light used, fibres appearing differently when dry and when moistened. Various moistening liquids gave different results. The colours shown in polarised light under the same conditions seemed to be chiefly dependent on the material nitrated and the method of nitration, and they cannot be regarded as a function of the degree of nitration. The densities of celluloses and of nitrocelluloses examined were found to be higher than those recorded in text-books. The densities of the nitrated material in solution were also determined and found to be higher than in the solid state. Observations of the refractive index of nitrated cotton in solution gave results which were not concordant, and therefore determinations were made on transparent films of nitrated cotton, ramie, and flax. The refractive index of cellulose was found by examining denitrated films and then by placing fibres in a liquid of like refraction. Atomic refractions were applied to some of the proposed formulæ for cellulose, and showed that the cellulose molecule has no double bonds.

Entomological Society, April 10.—Mr. C. O. Waterhouse, president, in the chair.—Wet- and dry-season forms of Pierinæ: Dr. F. A. **Dixey.** Specimens were shown of Pierinæ belonging to the genera Teracolus and Huphina. The exhibit was intended to illustrate the fact that in species of which the wet-season phases were very distinct from each other, the corresponding dry-season phases often could only be discriminated with difficulty.—Forms of Osphya and concurrent species: J. **Edwards.** Five forms of Osphya were shown, together with certain other species occurring at the same time and place, and, having regard to gait and appearance, resembling them more or less closely. It was not suggested that these resemblances are protective. Attention was also directed to an important function of the hind-legs of the male, namely, to secure him in position at the time of pairing.—Antennæ-joints in Trachiscelis: H. J. **Carter.** A microscopic slide prepared to demonstrate that the antennæ of the genus Trachiscelis have eleven joints, and not ten as hitherto described.—Odonata collected by Lieut.-Colonel C. G. Nurse, chiefly in North-Western India: K. J. **Morton.**—The life-history of *Cydimon* (*Urania*) *leilus*: L. **Guppy,** jun. This paper was followed by a discussion on the migration habits and classification of the species.

EDINBURGH

Royal Society, February 18.—Dr. Robert Munro, vice-president, in the chair.—The coat colour in horses: Prof. J. C. **Ewart.** (1) The remote common ancestor of the Equidæ was probably of a reddish-brown (foxy-red) colour. (2) Horses prior to domestication probably varied in colour and consisted of (*a*) species adapted for a forest life, having dark yellow-dun coat, a broad dorsal band and stripes more or less distinct on the face, neck, trunk, and legs; (*b*) species like Prejvalsky's horse, adapted for a steppe life, having a brown yellow or reddish-brown coat, a narrow dorsal band, but only at the most vestiges of shoulder and leg stripes; and (*c*) species adapted for a life on the plains, having a light yellow-dun coat and, in addition to a narrow dorsal band, only faint vestiges of stripes on the legs. (3) Yellow duns belonging to different varieties may, when crossed, give rise to bay and chestnut as well as yellow-dun offspring. (4) Bays obtained by crossing yellow-duns may, when crossed with pure yellow-duns, yield black and chestnut as well as bay offspring. (5) Chestnuts derived from crossing yellow-duns may, when crossed with pure yellow-duns yield white and bay as

well as chestnut offspring (6) When crossed with a yellow-dun a white may yield grey roan and white-dun offspring. (7) A black, crossed with a yellow-dun, may yield either yellow-dun or black offspring —The geology of Ardrossan Dr J D **Falconer.** A brief description is given of the geological structure of the area in the immediate neighbourhood of Ardrossan, the suggestion being made that the Upper Old Red Sandstone and overlying volcanic series were folded over an anticlinal axis striking north west and south-east behind Ardrossan The petrographical characters of the Carboniferous lavas and intrusive rocks are described in detail Of the latter, the most important is the sill at Castle Craigs, more than half of which is composed of picrite This rock passes upward into hornblende-dolerite along the whole length of the sill The upper portion of the intrusion is fine grained and banded parallel with the upper surface, and is crossed by small pink felspathic veins The sill affords an excellent example of the differentiation of one and the same magma into a lower basic and an upper felspathic portion It is supposed to present considerable analogy to the banded peridotites and gabbros of Skye, and to differ from the Blackburn and Barnton picrites near Edinburgh, in which the differentiation took place entirely after intrusion

March 4 —Prof Crum Brown, vice-president in the chair —Algebra after Hamilton, or multenions Prof Alexander **M'Aulay** *This is a system resembling in its* generality the *Ausdehnungslehre* of Grassmann, but built on the lines of Hamilton's quaternions It differs from the *Ausdehnungslehre* in having only one method of multiplication The theory of the "linity," analogous to the linear vector function in quaternions or to the matrix in algebra, is developed in considerable detail, also the closely connected method of differentiation, which is based upon the properties of the generalised ∇ —Note on the change produced in the conductivity and density of lead wires by permanent stretching J A **Donaldson** and R **Wilson.** The experiments were carried out in the physical laboratory of Edinburgh University The results were negative, there being within the errors of observation no appreciable change in either the electric conductivity or the density —The dynamical theory of seismometers Dr C G **Knott.** Some account was given of the recent important results, both theoretical and experimental, obtained by Prince Galitzin in his discussion of the theory of the horizontal pendulum, and a general discussion of earthquake records, now familiar to all students of seismology, led to the conclusion that, except for small, comparatively rapid vibrations of the ground, the amplitudes of the records could not be regarded as reproducing the motion of the ground even to a first approximation —Temperature observations in the North Sea Prof D'Arcy W **Thompson** In this communication the author gave an account of methods and results which form a part of the second report of the North Sea Fisheries Investigation Committee The material which formed the basis of the investigation was obtained partly from regular observations made at lighthouses and on lightships, and partly from observations, furnished twice a day, by captains of passenger steamers From these, by graphical interpolation fair monthly means of water temperatures on the surface and at various depths were obtained Many interesting results were arrived at, especially with regard to the changes of temperature throughout the year and the range of annual change in different regions of the North Sea See the Blue book recently published by His Majesty's Government

March 18 —Dr R H Traquair, vice-president in the chair —The influence of temperature on the photo electric discharge from platinum Dr W Mansergh **Varley** and F **Unwin.** The experiments were made in air, in carbon dioxide, and in hydrogen, at pressures varying, in each gas from atmospheric pressure to a pressure of 0·0035 mm of mercury In air and carbon dioxide at atmospheric pressure the photoelectric currents decreased with increase of temperature up to about 400° C, after which they began to increase again The maximum diminution in current was about 80 per cent of the normal value The behaviour of these two gases was identical In hydrogen at this pressure, on the other hand, the currents steadily increased as the temperature was raised from the ordinary temperature of the air At the lowest pressure (0·0035 mm) the photoelectric discharge in each gas was found to increase when the temperature was raised from that of the atmosphere to 60° C Further increase of temperature up to 400° C produced no change in the photoelectric current When the temperature was reduced to the ordinary temperature of the air, the sensibility of the surface gradually diminished with time, falling to half its value in about twenty-four hours In all cases time was required for the sensibility to attain a steady value after any change in temperature —*Spirophyllum ferrugineum*, a new genus and species of thread bacteria D **Ellis.** This flat, leaf-like, spirally wound organism was discovered by the author in iron-water ditches about a mile from Renfrew The width varied from 1 μ to 6 μ according to age, and the length might reach 200 μ The multiplication was by means of conidia, which germinated Immediately after germination the organism had a slight motility but this soon ceased Before deposition of the iron the cell was semi transparent This new genus connects the iron bacteria, which at present are placed in the Chlamydobacteriaceæ, or thread-bacteria, with Spiromonas, a genus which must therefore be now included among the thread-bacteria —The functions of the Rolandic cortex in monkeys Drs W A **Jolly** and Sutherland **Simpson** The object of the experiments, which were carried out in the physiological laboratory of Edinburgh University was to delimit accurately the motor areas in the cortex cerebri of the monkey The method employed was a new one The cortex was stimulated by unipolar faradisation, and the areas were isolated by the use of vulcanite plates The sharp edges of these plates were inserted into the cortex to a depth sufficient to divide the grey matter without penetrating the underlying white substance It was shown that the movements of muscles resulting from stimulation of the ascending parietal convolution were due to spread of current to the ascending frontal convolution The motor centres in front of the fissure of Rolando and on the mesial aspect of the hemisphere were mapped out by application of the same isolation method —Hydrates in aqueous solutions of electrolytes Rev S M **Johnstone** The paper gave results of extensive series of observations of the elevation of the boiling point and lowering of the freezing point in strong solutions, with determinations of conductivities at 0° C and 99°4 C In most of the curves showing the relation between concentration and elevation per gram equivalent there was a minimum point, above which elevation per gram equivalent usually increased with concentration at a gradually diminishing rate The hydration of the molecules and ions of the solutions examined was discussed on the admittedly doubtful assumption that the ionisation could be roughly determined from conductivity data Freezing-point and boiling-point data were found to give very similar values of the extent of hydration, the deliquescent salts giving the higher percentage hydrations The number of molecules of water of hydration per molecule of solvent for a highly concentrated solution of a non-deliquescent salt was found in some cases to be much less than the number of molecules of water of crystallisation

PARIS

Academy of Sciences, April 15 —M A Chauveau in the chair —Primitive tuberculosis of the lung and of the bronchial and mediastinal ganglions, communicated to young calves by the ingestion of tuberculous virus of bovine origin A **Chauveau** A review of the author's communications on the subject of tuberculous infection of the lungs through the alimentary canal, with especial reference to the recent work of Calmette —The application to pyridine of the method of direct hydrogenation by nickel Paul **Sabatier** and A **Mailhe** At moderate temperatures (120° C to 220° C) pyridine is scarcely affected by this reaction less than 1 per cent being acted on The amine formed is shown with certainty to differ from piperidine the expected reduction product and may possibly prove to be amylamine If the reaction is allowed to proceed at higher temperatures ammonia and pentane are produced in considerable quantities —Contribution to the pathogeny of pulmonary anthracosis S **Arloing** and J **Forgeot** A controversial paper directed against the

hypothesis of Calmette, Vansteenberghe, and Grisez—Researches on ammonium Henri **Moissan.** The contents of a sealed letter deposited November 5, 1906 The presence of water is not necessary to the production of ammonium amalgam, since it can be produced by the interaction of sodium on the chloride or iodide of ammonium in liquid ammonia at $-40°$ C This reaction is, however, only possible in the presence of an excess of sodium If the excess of sodium be removed by repeated washings with a solution of an ammonium salt in liquid ammonia the so-called ammonium amalgam no longer exists An account is also given of the product obtained by the electrolysis of the double iodide of mercury and ammonia in liquid ammonia—Prof Witz was elected a correspondant for the section of mechanics in the place of the late Prof L Boltzmann—The form of the geoid in the neighbourhood of Sahel Algiers MM **Bourgeois** and **Noirel**—A new method of regulating X-ray tubes G **Berlemont.** The arrangement proposed consists of an aluminium tube which can be connected at will to either the anode or kathode The tube can be made either hard or soft in a few minutes—The determination of the limits of inflammability of explosive mixtures of ether vapour and air Jean **Meunier** The lower limit of inflammability is about 75 milligrams of ether per litre of air, the upper limit is about 200 milligrams of ether per litre—The reduction of magnesia by carbon Paul **Lebeau** Magnesia is reduced by carbon at the temperature of the electric furnace with the production of magnesium and magnesium carbide Both products are in great part destroyed by the action of the furnace gases which diffuse through the carbon tubes This gas contains much carbon monoxide, and it is known that magnesium reduces this gas with great facility—Sulphide of aluminium and its combinations with manganese and iron sulphides Marcel **Houdard** Sulphide of aluminium, which is irreducible at the high temperatures of the electric furnace forms with sulphide of manganese and sulphide of iron two double compounds Al_2S_4Mn and Al_2S_4Fe, a description of the properties of these two substances being given—A new chloride of tantalum C **Chabrié** The new chloride is obtained by the reduction of tantalum pentachloride with sodium amalgam Its composition is given by the formula $TaCl_2 2H_2O$, and an account is given of its chemical behaviour—A method of synthesis of non-substituted β-ketonic amides Ch **Moureu** and I **Lazennec** The acetylenic amides heated in alcoholic solution with a secondary amine best with piperidine, give good yields of the corresponding ketonic amides—The migration of compounds possessing smell in the plant Eug **Charabot** and G **Laloue** The migration of these products from the leaves during inflorescence is proved—The Lutetian in the Soudan and the Sahara R **Chudeau**

DIARY OF SOCIETIES.

THURSDAY, APRIL 25

ROYAL SOCIETY, at 4 30—*Croonian Lecture*—On the Essential Constituents of the Nucleus and their Relation to the Organisation of the Individual Prof J B Farmer, F R S

INSTITUTION OF MECHANICAL ENGINEERS, at 8—Address by the President T Hurry Riches

INSTITUTION OF ELECTRICAL ENGINEERS at 8—Depreciation Provision on Electricity Supply Undertakings R Hammond

FRIDAY, APRIL 26

ROYAL INSTITUTION, at 9—New Illuminants James Swinburne, F R S

PHYSICAL SOCIETY at 5—Electrical Conduction produced by Heating Salts A F Garrett—The Influence of Pressure upon Convection Currents and a Criticism of J Stark's Relation between Cathode Fall of Potential and Temperature W S Tucker—Solenoids which are turned by the Earth's Magnetic Field W B Croft—Simple Apparatus for mechanically illustrating the Tangent and Sine Laws J A Tomkins

SATURDAY, APRIL 27

ROYAL INSTITUTION, at 3—Studies in Magnetism Prof Silvanus P Thompson, F R S

MONDAY, APRIL 29

SOCIETY OF ARTS at 8—Detergents and Bleaching Agents used in Laundry Work Prof. Herbert Jackson

ROYAL GEOGRAPHICAL SOCIETY, at 8 30—Polar Problems Dr Fridtjof Nansen, G C V O

INSTITUTE OF ACTUARIES, at 5—On Extra Premiums H E W Lutt

TUESDAY APRIL 30

ROYAL INSTITUTION, at 3—Stimulation, Luminous and Chemical Prof William Stirling

SOCIETY OF ARTS, at 8—Lustre Pottery William Burton

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Lantern Demonstration of Two Contrasted Types of North American Indians: Dr. A. C. Haddon, F R S

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting

WEDNESDAY, MAY 1

SOCIETY OF ARTS, at 8.—The Defence of the Sea Coast from Erosion: Alfred E Carey

ENTOMOLOGICAL SOCIETY, at 8.

GEOLOGICAL SOCIETY, at 8—On the Xerophytic Character of Coal Plants and a Suggested Origin of Coal Beds Prof. G Henslow—Petrological Notes on the Igneous Rocks lying to the South East of Dartmoor H J Lowe.

THURSDAY, MAY 2

ROYAL SOCIETY, at 4—Election of Fellows.—At 4 30.—The Spontaneous Crystallisation of Binary Mixtures Experiments on Salol and Betol Prof H A Miers, F R S, and Miss F Isaac—On the Variation of the Pressure developed during the Explosion of Cordite in Closed Vessels: Prof C H Lees F R S, and J E Petavel—Space described in a Given Time by a Projectile moving in Air A Mallock, F R S

SOCIETY OF ARTS, at 4 30.—The Applicability to India of Italian Methods of Utilising Silt Sir Edward C Buck, K C S I

LINNEAN SOCIETY, at 8—The Fauna and Flora of Abyssinia compared with Those of West Africa Prof E B Poulton, F R S—(1) Report on the Marine Biology of the Sudanese Red Sea (Communicated with an Introduction by the President), (2) Formation of the Shone Cliff near Alexandria (3) Recent History of the Coral Reefs of the North West Shores of the Red Sea Cyril Crossland—Polyplacophora collected by Mr Cyril Crossland E R Sykes—On Chelonethi (Pseudoscorpions) from Asia and Australia C J With—Note on the Function of the Spiracle in certain Elasmobranchs A D Darbishire—*Exhibits* (1) Probate of the Will of Richard Anthony Salisbury, (2) Manuscripts of Dr W J Burchell F L S Presented to the University of Oxford by Francis A Burchell, Esq, Rhodes University College Grahamstown, Grand-nephew of the Great Naturalist and Explorer Prof E B Poulton

CHEMICAL SOCIETY, at 8 30.—(1) The Chemical Action of Exradio, Part I, Action on Distilled Water (2) The Chemical Action of Exradio, Part II, Action on Copper Salts in Solution Preliminary Note Sir W Ramsay—Freezing Point Curves of the Menthyl Mandelates A Findlay and E M Hickmans.—The Constitution of Homo eriodictyol A Crystalline Substance from Eriodictyon Leaves F B Power and F Tutin—The Relation between Valency and Heats of Combustion Preliminary note G Le Bas

INSTITUTION OF ELECTRICAL ENGINEERS, at 8—The Use of Wooden Poles for Overhead Power Transmission C Wade

FRIDAY, MAY 3

ROYAL INSTITUTION, at 9—Dexterity and the Bend Sinister Sir James Crichton Browne, F R S

GEOLOGISTS ASSOCIATION, at 8—The Igneous Rocks of the Bristol District Prof S H Reynolds—The Carboniferous Limestone Sections of Burrington Combe and Cheddar T F Sibly—Recent Researches in the Lower Carboniferous Rocks Dr A Vaughan

SATURDAY, MAY 4

ROYAL INSTITUTION, at 3—Scientific Work in the Sea Fisheries Prof W C McIntosh

CONTENTS.

SUPPLEMENT TO "NATURE"

VIRCHOW'S LETTERS TO HIS PARENTS

Rudolf Virchow Briefe an Seine Eltern, 1839 bis 1864 Edited by Marie Rabl geb Virchow Pp xi+244 (Leipzig W Engelmann, 1906) Price 5 marks

IN an excellent and yet modest introduction to her father's letters, Frau Rabl expresses the opinion that they have "almost the value of an autobiography", in this she underestimates their worth, for even at the best an autobiography is but a picture drawn long after the early struggles are over, whereas we have here a picture painted as the events happened, and painted with a rare skill and uncommon intimacy, because it was not drawn for the public gaze, but for his father's eye Even had Virchow become, as was originally intended, merely a surgeon in the army, and had he remained as at one time he feared, simply a unit in the great average mass, these letters would still have a permanent value as an interesting record of student life in Berlin during the fourth decade of last century, but since they depict the struggles of youthful years which culminated in a triple triumph at the dawn of manhood they form indeed one of the most important contributions ever made to the study of great men Before his thirtieth year Virchow had overthrown a speculative pathology which regarded disease as a manifestation of humours of the blood, and by the application of the methods used in the more exact sciences and the use of the microscope replaced it by one which rested on a solid foundation of fact He had by then begun the study of the antiquities and people of his native province of Pomerania, by then he had thrown in his lot, at the risk of place and life, with the patriots who sought to curtail the autocracy of the crown and ameliorate the condition of the poor and oppressed He was a splendid fighter and he fought for truth and freedom in politics as well as in science

Virchow himself held the opinion that the key to a man's mental development was not to be found in a study of the outward events which everyone might see, but in an intimate knowledge of the inward events, which only the man himself could know But even when these letters have supplied us with a knowledge of both outward and inward events we are still at a loss to explain why it was that an only son of a small farmer in a Pomeranian village who received the orthodox education of an army surgeon, became the Virchow we known in pathology politics and anthropology Heredity scarcely helps us, his father with the best will in the world, only succeeded in continually mismanaging his small farm and was permanently in financial straits, his mother we can picture from a letter Virchow addressed to her while he was still a junior student in Berlin, in that he enjoins her to give over complaining of the hardness of fate—what she names fate, he says, is merely the result of human deeds—and advises her to cease confiding her domestic troubles to chance acquaintances Her love and meekness towards him were unbounded His uncle on his mother's side was an architect of some repute in Berlin, his uncle on his father's side laboured with success to improve the accoutrement of the Prussian soldier

The circumstances of Virchow's youth resemble very closely those of Ruskin, except that Virchow's father was a poor man Both were only children in both cases the father was the dominant partner and took elaborate pains to teach the child to observe, in both cases the children by the time they reached early manhood, had fixed their gaze on a universe while their fathers' eyes never strayed far beyond the village pump, with the natural result that the intimate relationships between father and son became sorely strained "Only you misunderstand me" the youthful Virchow writes to his father "if you think my pride and self-confidence spring from my knowledge, its blanks I know best, they spring from a consciousness that I desire better and greater things and strive more earnestly for a full and complete mental life than most men His father had accused him of being self-conceited egoistical, and wildly utopian Much of the correspondence relates to finance and clothes Virchow senior counsels the purchase of ready-made trousers, "everybody who knows advises me against them" replies his son—and the son always took his own way In his early student days he set his heart on a felt hat but managed to jog along by borrowing one until the spring came when the particular fashion of that year had declared itself and he had accumulated sufficient funds for the purpose of purchasing a new one "It is sad to think" he writes "that my whole future should hang on a seasonable fall of rain or a few weeks of good weather in the harvest" Virchow never forgot the little farm "How does the corn look?" he continually asks "are the meadows doing well?" Even when his name was known in all the capitals of Europe he promises his father to be home in harvest to give him "a hand with his potatoes"

Some years ago the writer of this notice inquired into the circumstances which led to young men taking up the study of medicine In seven cases out of one hundred the reason was found to be that medicine was the only means of livelihood open to them which gave an opportunity of continuing a study of the natural sciences especially botany and natural history That was the reason which led Virchow to the study of medicine, at school the natural sciences were the hobbies of his spare hours Things have changed since Virchow's day nearly all the men who occupied the chairs of chemistry botany and natural history were then trained for medicine, nowadays one may hope to make a livelihood as well as a hobby of them

One is surprised to find so little mention of Johannes Muller in these letters his was the master mind among Virchow's teachers He must reckon among his pupils all the men who made Berlin a

great medical centre—Du Bois-Reymond, Brucke, Haeckel, Helmholtz Henle, Remak, Schwann, and Virchow Virchow himself would be the first, in his maturer years, to acknowledge the debt he and all Germany owes to Muller A K

INORGANIC CHEMISTRY

Introduction to General Inorganic Chemistry. By Prof Alexander Smith Pp xviii+780 (New York The Century Co, 1906)

Systematic Inorganic Chemistry from the Standpoint of the Periodic Law By Dr R M Caven and Dr G D Lander Pp xix+374 (London Blackie and Son, Ltd 1906) Price 6s net

AMONG recently published chemical books, of medium weight, as the clothiers say, these two are worthy of particular attention, for they embody careful attempts to present chemistry in a somewhat new way, and they have, each of them, a distinct individuality

Prof Alexander Smith, of Chicago has already expressed his views on the whole subject of chemical teaching in a work reviewed in these columns a few years since and he has published a "Laboratory Outline of General Chemistry" which has many merits, and has received the compliment of translation into German We turned, therefore, to his present exposition of general inorganic chemistry with special interest and with considerable expectations This new book embodies an attempt to interweave as much of the theory and detail of inorganic chemistry as will provide a reasonable course for a student entering upon the study of chemistry at a university Prof Smith adopts the plan of developing the theory piecemeal so that

"no conception is defined and no generalisation or law is developed until such a point has been reached that applications of the conception and experimental illustrations, later to be related in the law have *already* been encountered and there is about to be occasion for further applications and illustrations of the same things in the chapters immediately succeeding"

This is a difficult plan to carry out thoroughly in a science where there is really no one clearly definable sequence of topics that is the most natural or logical, and where indeed the most elementary facts and most familiar phenomena will, if we like, provoke the most far reaching questions of theory But Prof Smith has met the difficulties of his task with great skill, and has given us a very judicious and well-balanced selection of the facts of inorganic chemistry with a body of theoretical information little less than is to be found in a fairly advanced work on physical chemistry In this last direction the author has gone much further than most writers of modern text books, and his exposition of principles is in many respects original in form, and for that reason all the more interesting The divorce between inorganic and physical chemistry is admittedly artificial, and no one can question that great gain to the study of inorganic facts is derived from the application of chemical dynamics and the doctrine of equilibrium The infusion of electrochemistry, accompanied by the doctrine of ionic dissociation, will not be so universally acceptable, but probably most chemists will consider the introduction of the new dualism entirely justified by the present state of knowledge

Whilst Prof Smith has skilfully handled the theoretical matters which he has introduced, we cannot help thinking that he has attempted rather too much, and that in some cases the compression of the treatment imposed by the limits of the book will leave the student in the possession of thin knowledge and vague ideas The part of Prof Smith's book that seems to the present writer to be the least satisfactory is the introduction (chapters i. to iv), and this is the more to be regretted as it may prejudice the reader at the outset and deter him from proceeding to the vastly better material beyond The fault that is to be found is one not uncommon in American books, though it is of Teutonic origin, it is the attempt to read into chemistry a kind of philosophical completeness and logical exactitude which it does not really yet possess The delimitations of an "abstract concrete science," the meaning of "explanation," the explanation that "a cause is a condition or occurrence which always precedes another condition or occurrence" "stochastic and formulative hypotheses," the review of iron and sulphur with a view to the distinction between chemistry and physics, these seem hardly fruitful topics

Nor do we think that Prof Smith is happy in his treatment of them On p 5 it is stated in leaded type that

"the most obvious characteristic of a chemical phenomenon is that all the physical properties of the substance alter, that this alteration is abrupt that, in fact the products are different substances that the recognition and study of such a phenomenon is accomplished entirely by observations of a physical nature"

Now is this true of so simple an occurrence as the heating of a piece of chalk? Where is the obvious and abrupt alteration of all physical properties?

Again, on p 32, the leaded statements distinguishing between an element and a simple substance are almost cryptic in their subtlety, besides being mere dogmas as applied to members of the argon family

These examples might be multiplied, but enough has been said to indicate an objection that will be felt, we venture to think, by most readers, in relation to this exceptionally valuable and interesting book It might be worth considering whether, if they are to be retained at all, these philosophic excursions should not be confined to an appendix

Drs Caven and Lander have written a compact work on inorganic chemistry from the standpoint of the periodic law, intended for students who have reached the last stage of their degree course It is entirely different in scope and style from the work just noticed, and it has its own very distinct merits. It will probably satisfy admirably the requirements of students who desire to knit up the "ravelled sleeve"

that usually results from two years of the most conscientious teaching of inorganic chemistry, no matter how, by whom, or to whom the teaching be administered. The book is condensed, but it is not dull, there is, in fact, a sort of grip about it which is decidedly sustaining. Many subjects of difficulty, such as the complex cyanides and the amines, are treated with much clearness and perspicuity and most new things in inorganic chemistry are well elucidated. It is really a work on systematic chemistry, a study of chemical compounds *per se*, detached from all the arts of man, a sort of comparative anatomy based on the periodic law. Judged from this point of view, and not as a work that purports to contain all that a degree student should know of inorganic chemistry, it seems to the present writer as good as any work that has been written with the same object, and a great deal better than most of them.

Very few mistakes have been noticed in reading the book, but the expression (p. 8), "the modified form of Gay-Lussac's law is Avogadro's law," would shock the author of the first book under notice, and it is certainly not felicitous. On p. 44 the hydrides of sodium and potassium are (in view of Moissan's work) unfairly denied the character of definite compounds, and on p. 202 nitrogen trioxide is said to dissociate completely into nitric oxide and nitrogen peroxide on evaporating. The authors propose and use the terms *basigenic* and *oxygenic* respectively for base-producing and acid-producing, and there seems to be some need for such words, it is certainly confusing to speak of the basic properties of oxygen and the basic properties of caustic soda.

ARTHUR SMITHELLS.

GEOGRAPHY FOR SCHOOLS.

A Progressive Course of Comparative Geography on the Concentric System. By P. H. L'Estrange. Pp. xii+148. (London: Geo. Philip and Son, Ltd., 1906.) Price 6s. net.

Philips' Progressive Atlas of Comparative Geography. Edited by P. H. L'Estrange. Pp. 148. (London: Geo. Philip and Son, Ltd., n.d.) Price 3s. 6d. net.

Stanford's Octavo Atlas of Modern Geography. Third edition. Pp. 104+50 maps. (London: Edward Stanford, 1906.) Price 25s.

THE very title of Mr. L'Estrange's book expresses an admirable idea. The graduation of geographical teaching in such a way as to adapt the matter to boys and girls of different ages, and yet to make it educational at every stage, and hence to present at successive stages tasks of gradually advancing difficulty, is admittedly one of the hardest and at the same time one of the most important problems which the teacher has to face. In his attempt to accomplish this task Mr. L'Estrange has produced a work on which a very great amount of thought and pains have been bestowed, with such a wealth of instructive maps extremely useful for teaching purposes, and of equally instructive pictorial illustrations, and with a text possessing so many valuable features, that it may be unhesitatingly and cordially recommended to every teacher of geography.

It is to be regretted, however, that one cannot feel the same confidence in recommending the book for the use of the pupils. Notwithstanding all that Mr. L'Estrange has succeeded in doing, notwithstanding the fact that he has made important contributions to the solution of the problem that he has set himself, it can scarcely be admitted that he has been quite successful in so mastering the store of information he has amassed as to lead the learner securely onwards in the manner he has designed. This results partly, it would seem, from the fact that he has never formed any clear conception of the function of geography as distinguished from geology. He gives us no definition of the subject, but opens at once with an account of the structure of the earth's crust such as is given by the geologist. The greater part of this account is, no doubt, also of geographical interest, but if Mr. L'Estrange had recognised the fact that geography and geology differ in their points of view, he would probably have given less importance to some and greater importance to other parts of his physical geography.

The main feature of Mr. L'Estrange's work is an attempt to graduate the subject in three stages, A, B, and C, the A stage suitable to the lower section of a school in which a boy may spend two years, the others to the higher sections. The boy is intended in each successive stage to go over the same ground, to gain additional knowledge and to exercise his thoughts on more difficult problems in the higher stages, but "all without overlapping or ill-ordered acquisition of knowledge." This plan is followed both in the text and the maps, and the manner in which it is carried out in the maps is one of the most important contributions the author has made to the accomplishment of his task.

The plan is in a large measure sound, but probably most teachers will be disposed to think that he has pushed the idea of covering the same ground at every stage too far. They will question whether some of the subjects dealt with are suited for the A stage at all, for instance, that of map projections, which is distributed in a very unsatisfactory manner over stages A, B, and C. This fault, however, can be remedied by the teacher himself reserving the entire subject for the C stage. It is a more serious defect where we find that a reference to a higher stage is necessary to the complete understanding of a lower one, or ideas suited only to a more advanced stage are introduced in the treatment of subjects quite proper to a less advanced stage. Thus on p. 12, after the consideration of the whole subject of running water, we are suddenly introduced in stage A to the conception of alluvial valleys, explained as "flat plains of rich soil deposited by rivers in their lower courses", yet in the general treatment of running water in the A stage there is no account of the formation of such plains, to understand which one has to consider an action (of a quite simple character) reserved for the C stage, while in the A stage of the general matter we are introduced to the very difficult conception of

a "graded river" It is still worse to meet with statements that cannot but tend to beget confused thinking on the part of the learner, as where we are told that "on a flat surface streams begin by cutting deep perpendicular-sided ravines as in the cañons of Colorado" (p 8, col 2), or where from the wording of the text, a boy would be led to believe that a river in subsiding after a flood deposits matter only along its banks (p 9, col 1), or where he is told (p 32, col 2) that "the length and direction of rivers [in Great Britain] are largely determined by the surface features," which ought to lead him to try to think what other circumstances may contribute to determining those things These points may seem trifles, but for the A stage more particularly it is essential that the statements should be strictly accurate and unequivocally clear More serious misconceptions are sure to be engendered by such statements as that "the circulation of the waters of the ocean brings warmth to the coasts of British Columbia and Western Europe" (p 18, col 2) That is quite true if we understand by the coast the mere line of contact of land and water, but boys and girls ought to understand and never forget that it is not true 6 inches inland Indeed, the whole of the important subject of temperature is very inadequately treated There is no systematic development and consistent application of the fact stated on p 16, col 1, that "movements of air naturally bring warmth to cooler regions or coldness to warmer," and the neglect of this, one of the most serious omissions apparently due to the failing to form a distinct conception of the function of geography, gives rise to other statements in the book that cannot but mislead

In the preface, Mr L'Estrange points out that in most of the maps in his book the projections adopted are such as show the parallels of latitude by straight lines For larger areas the projection most frequently used is the homalographic, which is indeed very good where comparisons of area are important, but is not satisfactory for wind maps, for which it is used in Plate 4, with the result that in the January map the arrows representing the direction of the wind over the Yellow Sea and the Sea of Japan will be read as indicating north-west winds if we refer them to the parallels of latitude, but nearly due north if we refer them to the meridians By Mr L'Estrange Mercator's projection is eschewed throughout, but in spite of its obvious faults, for wind maps there is none better

The coloured plates, sixty-nine in number, of Mr L'Estrange's book are now to be had separately under the title of Philips' "Progressive Atlas of Comparative Geography" They consist mainly of maps on each of which there are either names or references by means of letters and numbers printed in brown, blue, and red On the named maps the brown names are those which it is considered proper for the boys and girls in the A stage to learn, those in B learning also the blue, and those in C adding the red The maps with references are in other respects duplicates of the named maps, and are intended as test maps In addition, there are various climatological, commercial, and industrial maps and diagrams, all well executed for the purpose for which they are intended. The "Atlas," like the corresponding plates in the "Geography," is provided with an index on a simple and ingenious plan, only the nearest degrees of latitude and longitude marked on the map being given, with the bearing from the intersection of those lines. Thus Nagpur is entered 20 80 N W., meaning that it lies north-west of the intersection of 20° N, 80° E, a method which enables one to find the place on the map referred to with great ease. Unquestionably this "Atlas" is fitted to be extremely useful in schools

"Stanford's Octavo Atlas" is well known for its merits of handiness, of as much fulness as is compatible with its size, and as much clearness as is compatible with its fulness In this new edition the more important changes that have taken place on the map of the world since the last edition are indicated The difficulty of inserting new names on the maps might to some extent have been met by inserting them in the index, where the excellent plan is adopted of including more names than are to be found on the maps, so that those who use the atlas are at least enabled to fix the position of a place on the proper map, and thus see its relations to the places which are named thereon The fact is, however, that some names, such as Kotlass in Russia and Nelson in British Columbia, have already found a place on maps, but not in the index For a new edition it would be well to reprint this index, abandoning the present plan of giving no reference to the number of a map, but only the name of the country to which a place belongs Thus one gets the latitude and longitude of a place in Canada, then has to refer to the table of maps at the beginning, and, finally, to ascertain in which of the three maps of Canada there enumerated the place is to be found In reprinting the index the opportunity might be taken to insert all places omitted GEO G CHISHOLM.

PHOTOGRAPHY FOR COLLEGE STUDENTS.

Photography for Students of Physics and Chemistry, By Prof. Louis Derr Pp vii+247 (New York The Macmillan Company, London Macmillan and Co, Ltd, 1906) Price 6s net.

PROF DERR is hard to please He says that good handbooks of photographic manipulation are abundant, but they are apt to be unsatisfactory because their business is not to explain principles Of complete treatises there are also not a few, but in them the thoughtful student is likely to be "overwhelmed with an avalanche of detail and history"; and monographs are too highly technical and "confined to such limited portions of the photographic field that the desired information generally lies in the gaps between them." He has, therefore, endeavoured to prepare a volume that suffers from none of these disadvantages He may have suited his book to the needs of his students, but the result

to a stranger presents itself as a very uneven treatment of the subject.

While lenses have eighty-nine pages devoted to them, more than a third of the volume, all the various methods of silver printing are dismissed in but forty-four lines. We find that toning silver prints has fourteen lines devoted to it, platinum printing twenty-two lines and two equations, while the use of spoiled lantern plates by cleaning off the films and utilising the glass compares with the above important subjects with its twenty-nine lines The incompleteness of the consideration of some other subjects, such as halation and intensification, leads sometimes to statements that may convey a false impression We read, for example, that by continuing the development of an exposed gelatino-bromide plate "the image will gain steadily in density until all the silver present has been reduced, when of course the process ends"—a statement that even mere rule-of-thumb photographers know, often to their cost, is not true Here, as in one or two other cases, theoretical considerations seem to have misled the author with regard to facts In short, he does not seem at home in the treatment of what might be called the more strictly photographic parts of the subject

It is easy to discover the sections of the subject that the author delights in, and it is in these that the value of the book consists The chapters on lenses do not go deeply into the matter, but they are interesting and clear, and give those details that students want The representations of the light reflected from the glass-air surfaces of single, doublet, and triplet lenses, and a lens with four separate glasses, are novel as book illustrations and very instructive In the directions given for testing a lens for its defining power, the fact that commercial plates are not flat is very properly emphasised, but this fact is overlooked in the method given for testing a camera for "register" It is to be regretted that depth of definition is treated of in the orthodox manner, namely, only as it affects that part of the plate immediately adjacent to the lens axis In direct contrast to this, the author does not follow in the footsteps of most of his predecessors with regard to illumination, considering the effects of focal length and aperture only, but demonstrates exactly how the brightness of the image on the plate must fall off at a distance from the lens axis under even the best experimental conditions

The chapter on exposure shutters shows that the author is practically familiar with them He gives the main facts concerning them, and the methods that he has used himself in investigating their mode of action He gives a table, two and a half pages in length, of the distances that a body falls in each hundredth of a second for a distance fallen of from 2 feet to 20 feet This ponderous method of timing shutters is surely obsolete The rotating bicycle-wheel method is also described, as well as methods of investigating efficiency

Photomicrographs of the grain of plates that have been subjected to various treatments are a notable feature of the work C. J

THE FAUNA OF THE TAY DISTRICT

A Fauna of the Tay Basin and Strathmore. By J. A Harvie-Brown Pp lxxxvi+377, plates and maps (Edinburgh D Douglas, 1906) Price 30s

WITH the appearance of this handsome work the author has the satisfaction of having completed the tenth volume of "A Vertebrate Fauna of Scotland", and we have great pleasure in congratulating him on having progressed thus far with a task stupendous enough to have frightened any man from attempting Not that Mr Harvie-Brown has written the whole, or anything like the whole, of the preceding nine volumes On the contrary, he was associated at the commencement of his work with the late Mr T E Buckley, who contributed largely to several of the volumes, while the second volume—on the birds of Iona and Mull—was written by the late Mr H D Graham, and the late Mr H A Macpherson was joint-author (with the editor in chief) of the one on the fauna of the North-west Highlands and Skye The volume on Shetland is again, the work of Messrs Evans and Buckley Nevertheless, the burden of the work as a whole has been borne by Mr Harvie-Brown and if he live to complete his task the author of the present volume will have accomplished for the whole of Scotland what his coadjutor Macpherson did for "Lakeland", and this, too, in a style which few can equal and none surpass For Mr Harvie-Brown is not only an exceedingly careful and industrious investigator, who will never let go a trail until he has hunted it to the end, and will never rest satisfied until he has completely refuted a doubtful assertion, but also a writer gifted with the power of putting facts in a pleasant light and of interesting his readers (who we hope are many) from start to finish He is, in fact, both an accomplished and elegant writer and an enthusiastic and painstaking field-naturalist—a combination which can scarcely fail to produce attractive and trustworthy work, as it has done in the volume now before us

As to the importance of works of this nature—more especially to those who come after us—no words of ours are necessary With the exception of one of a dotterel on her nest by Mr C Kearton, and of a second of the Perthshire Museum, the illustrations in the present volume are by Mr W Norrie, and when this has been stated, any commendation would be superfluous

In two respects the author has been specially favoured by adventitious circumstances in the case of the present volume In the first place, the area of which he treats lies in the heart of that great bay on the east coast into which the estuaries of the Tay and the Forth discharge, and it is consequently one peculiarly favourable for the arrival of birds migrating or driven from the eastward That such is really the case is evident by a glance at the map of the spread of the little auk over Scotland, facing p lxxxv In the second place, Perthshire possesses a number of local observers specially interested in the fauna of the district, and likewise a museum entirely devoted (as it should be) to the illustration of the local natural history As examples of the richness of the avifauna

of the district, reference may be made to two lists of birds seen on single days given in the introduction. In the first of these the author records having seen from the road thirty-four species of birds during a drive in the Crieff district, while in the second no less than fifty-four are mentioned as having been seen by the Duchess of Bedford during a few hours' watching at Meikleour

In the matter of nomenclature the author sticks to the scientific names which have been so long in general use for British mammals, while in the matter of the limitations of genera he likewise follows the old-fashioned usage, retaining, for instance, the blackbird and the ring-ousel in the same genus as the thrush He will not even accept Microtus in place of Arvicola, for the water-rat and its relatives, while as to the proposal to adopt Myotis for certain bats, he will have none of it In one point, and one only, we take serious exception to the author's classification—namely, in his reference of the slow-worm to the Scincidæ in place of to the Anguidæ, of which it is the type

Were space available, nothing would please us better than to refer at length to many of the author's observations on birds and mammals; but editorial restrictions peremptorily forbid, so that we can mention only a few points

Two of the most interesting features in the book are the maps showing the recent spread and increase of the starling and the tufted duck in Scotland In the former case the map

"shows two distinctly different movements in dispersal of the same, or (?) closely related races of starlings one from the north and east (and possibly from Faroe also), and one by purely increase and extension from the south In the map of the tufted duck's nesting-dispersal the advance is shown of a species coming for the most part from the south by simple increase, but suggesting also more than merely a south-to-north direct increase and something of a possible arrival from the east, along the two very principal routes which are followed by migrants at the present day"

Is there, we wonder some general unsuspected cause connected with these and other recent colonisations?

Of equal interest are the observations with regard to the advent and spread of the squirrel in this and the adjacent districts The author might, however, have referred to the fact that the British squirrel is certainly a well-defined local race

In many cases, as we have seen the author has chronicled the steady increase and spread of birds In other instances, on the contrary, he has the melancholy task of recording their impending extermination "Meanwhile," he writes, for instance, "our ospreys are on the verge of despair, they are in anticipation of rapid and final extinction" Although he adds that the resources of civilisation may even yet come to their assistance ere the curtain is drawn The goshawk and the kite, although formerly abundant, now only linger on as stragglers Mr Millais, who had a pair from a keeper at Rohallion, writes that

"It is a pity he destroyed them, as they are probably the last pair that bred in the country. Rohallion, with its great craggy fir-woods, was to my knowledge the last stronghold of both goshawks and kites"

With this reference to the end of the kite and the goshawk as breeding species, we must likewise reluctantly bring to an end our survey of an admirable volume R L

GEODETICAL TABLES

Auxiliary Tables to Facilitate the Calculations of the Survey of India Fourth edition Revised and extended, under the direction of Colonel F B Longe, R E, by Lieut-Col S G Burrard, R E, F R S. (Dehra Dun Office of Trigonometrical Branch, Survey of India, 1906) Price 2 rupees

THE growth of the Indian Survey and the improvements that have been introduced from time to time are to some extent mirrored by the increase in size and usefulness of the tables, which the department find it necessary to publish The fourth edition of these useful tables "to facilitate the computation of a trigonometrical survey and the projection of maps for India," which fill a tolerably thick quarto volume, bears possibly the same relation to the modest first edition that the work of the survey of to-day does to the work accomplished some sixty years since In that first edition only seventeen tables appeared Each successive issue increased that number, till now we have no fewer than sixty nine tables and six appendices containing useful matter likely to prove of assistance to geographical explorers

This new issue and wider employment of tables tells also of the changes that have been made in the method of projection used in the construction of Indian maps In the olden time the projection was so arranged that while the central meridian of a map was a straight line, all others were curved and concave to the central meridian This was found to be inconvenient, especially when it was required to place two maps together so as to form a single map A modified polyconic projection, in which all the meridians are straight lines is now employed This system, introduced by General Walker, will in future be used for all maps on the scale 1 1,000,000 and larger scales

With regard to the tables themselves, they necessarily take the form that long experience has approved This is a sufficient answer to any criticism, but to those who have been accustomed to a different method of calculation it may seem strange to find the logarithms of numbers less than unity affected with a negative sign As doubts have lately been expressed of the superiority of the method employed in astronomical calculations, it is not unimportant to notice that so influential a body as the Indian Trigonometrical Survey prefers to retain the use of a negative characteristic There are not, however, many tables in which this peculiarity is required Many tables have reference to "Graticules of Maps," and give the sides and diagonals of areas varying from $\frac{1}{16}$ of a degree to four degrees, on such scales as are used in the department

In the meteorological tables, if one might make a suggestion, it would be to the effect that Loomis's coefficients for determining the differences of height with the barometer might have been superseded by the results of more modern investigations, such as those of Angot or Rykatchef. Applying what appeared to be more trustworthy values to the example quoted, a result was obtained which differed some fifty feet, or about three-quarters per cent., from that given. This discrepancy seemed too large, but some of it may be due to want of experience in the use of tables. It would be interesting to know what degree of accuracy has been reached in the determination of heights by means of the barometer, and what is the correct way of assigning an average temperature, moisture, &c., to the mass of the atmosphere between the two stations. A not inconsiderable error must be introduced by unknown variations of temperature, accompanied, as these may be, by possible inversions.

THE CENTRAL NERVOUS SYSTEM

Das Cerebellum der Säugetiere. Eine vergleichend anatomische Untersuchung. By Prof. Louis Bolk. Pp. 337, illustrated. (Jena: Gustav Fischer, 1906.) Price 15 marks.

PROF. LOUIS BOLK has risen far above the opportunity that the title of this work would seem to offer, and has written a book of quite uncommon interest. To this success several factors have contributed. In the first place his own labours and those of Profs. Charnock Bradley and Elliot Smith, to whom he makes due acknowledgment, have brought much new light and interest to the subject. Symptomatic of this triad advance is a new nomenclature of a somewhat unfortunately triune character, varying from simple numerals to idyllic descriptive terms.

In the second place, the author has stepped beyond the limits of rigidly specialised morphology, and has entered the arena of general science. His courage carries him beyond the assertion that morphology is of profound interest to the physiologist, into the statement that morphology is a high road, although a narrow one, to the elucidation of function. It is a bold theme, and has rarely been better emphasised, but in this case its application is obviously weakened by the morphologist's concentration on the value of mass. A knife, some spirit, and a plate, a pair of forceps and a jar or two, together form but a pioneer outfit with which to delimit the frontiers of function, or even of structure, in the central nervous system. A microscope and the methods of the histologist would have added marvellously to the data upon which such a theme might have been sustained. This notwithstanding, the enthusiasm of its sustentation has greatly added both to the interest of this book and to the value of the work on which it is based.

Many anatomists, for the convenience of description, have divided the cerebellum into a median portion, the vermis, and two lateral hemispheres. According to the author, the pursuit of convenience has here overclouded important facts. The cerebellum is primarily divided into an anterior and a posterior lobe, and it is only in the latter that there is any real distinction into mesial and lateral lobules. He has carefully examined the correspondence between the mode of growth of the cerebellum and this true lobulation, and concludes that the organ grows by expansion from a definite series of centres, and that these centres are in a large measure independent, as is shown by their relative behaviour in different mammalian cerebella. From this point Prof. Bolk advances with the postulate that the functional capacity of each domain must have the same independence. Further, since the function of the cerebellum as a whole is to play some part in the adequate performance of muscular movements, each of these centres must control some particular province of movement. From this it is but a short step to the allocation of function. Symmetrical movements are controlled from mesial centres, asymmetrical movements from lateral centres. The more anterior the muscles involved the more anterior the centre. It therefore follows that the anterior lobe is concerned with movements of the head, eyes, tongue, jaws, larynx—all parts in which symmetrical movement is the most common. In the posterior lobe the first centre is also a mesial one, and controls the neck. Then follow both mesial and lateral centres for the control of the limb movements, and so on.

This method has at least induced the author to make most interesting comparisons between the cerebella of different mammals. When the animal's mode of progression is a symmetrical one, the lateral limb centres are small, the mesial large and complicated; when asymmetrical the relation is reversed. Where, as in the giraffe, the neck assumes a new importance, there is a coincident expansion of an appropriate mass in the cerebellum. In ruminants—but this is not quite so certain—there is an appropriate enlargement of the jaw-centre in the anterior lobe.

Now there is much probability in the idea that definite portions of the musculature are primarily connected with appropriate districts of the cerebellar cortex. Nerve-fibres ascending from the medullary nuclei doubtless enter the cerebellum as definitely marshalled as are their precursors in the spinal cord. It is extremely likely that outgoing fibres leave it no less well arranged. Most probable, too, is the idea that fibres from cephalic districts are distributed to anterior portions of the cerebellum. The crude forms of experiment which have up to the present been made available, may even for some time prove no more than this. It is certainly, therefore, to the credit of Prof. Bolk to have arrived at similar ideas by means of his, unfortunately also crude, methods of observation.

When the full meaning of the cerebellum is discussed, there is, however, a demand for evidence of a somewhat different kind. We have acquired a taste for the kind of evidence that Prof. Sherrington has brought to bear upon the function of the spinal cord. This is the attitude of Prof. Bolk, and it is a wise one. The elongation of the giraffe's neck is, as he

himself points out accompanied by more than an added complexity in the movements of this particular district There is a new "figure" to equilibrate It might also be suggested that there is something new in the location of eyes and semicircular canals at the end of so long a flail

No one interested in the central nervous system can read Prof Bolk's book without attention or without criticism J S MACDONALD

PARTIAL DIFFERENTIAL EQUATIONS

Theory of Differential Equations By Dr A R Forsyth F R S Vol v pp xx+478 vol vi pp xiv+596 (Cambridge University Press 1906) Price 25s net

THE appearance of these volumes marks the happy conclusion of a work undertaken as the author reminds us in his preface twenty one years ago Doubtless it would have been finished earlier had it not been for unavoidable interruptions but the delay must have brought its compensations because many most interesting developments are of recent date

Vol v deals with equations of the first order and immediately suggests two reflections one that Lie has made the most important contribution to the subject since the publication of Jacobi's memoirs and the other that it is a great help to have such an out line of Lie's theory with Mayer's simplifications as that given in chapter ix The Jacobian theory too with Mayer's developments is given in chapters iii iv in a very attractive and readable form Chapters vi vii viii are mainly concerned with characteristics and embody much of the work of Cauchy Monge Lie and Darboux as well as original contributions by Prof Forsyth himself

It may be a rather far fetched comparison but there does appear to be a kind of analogy between the achievements of von Staudt and Lie Von Staudt's treatise on projective geometry does not contain a single diagram but it is beyond question the most masterly work on the subject Lie is almost if not quite as chary of graphical illustration but the spirit of his work is geometrical throughout and he stands in the same sort of relation to Monge that von Staudt does to Steiner It is most interesting to see how the canonical equations of dynamics (pp 398–406) are illuminated by the theory of contact transformations and again it is mainly Lie's ideas which have prepared the way for a thorough discussion of *all* the solutions of a partial differential equation including the special integrals which do not come into the ordinary classification

The great advance which has been made arises from considering a differential equation not merely as representing a property of a function assumed to exist but as defining an aggregate of elements which are most vividly realisable in a geometrical form In partial differential equations of the first order these elements may be taken to be tiny fragments of planes scattered about in space the differential equation defines the system of elements, and a complete integral, if it exist represents the collecting of the elements into surfaces, which form a family In Clebsch's treatise on geometry there is a chapter on connexes to which he evidently attached importance, and which has obvious relations not only to mixed concomitants but also to ordinary differential equations. If it has not been already done, it might be worth while to see whether something might not be made out of these relations Clebsch's work has, of late, rather suffered neglect Again, it may be suggested that in dealing with partial differential equations of the second order it might be helpful to associate with given values $(x\ y\ z\ p, q\ r, s, t)$ a fragment of a surface of the second order just as a fragment of a plane is associated with $(x\ y\ z\ p, q)$. That fragments of this kind are less likely to be associable so as to form surfaces than corresponding plane elements is tolerably plain and partly accounts for the increasing difficulty of treating equations of the second order without making particular assumptions.

Vol vi of the present work is practically devoted to partial differential equations of the second order Thus we have chapters on Laplace's linear equation, with the elegant developments of Darboux, Moutard, and others the methods of Monge Ampère Boole, Darboux Hamburger &c with instructive comparisons and examples worked out each way, together with a chapter on general transformation embodying the most important of Backland's results As an example of the power of Lie's methods even in the production of beautiful *particular* theorems the proposition on p 295 may be quoted —

> When an equation of the second order (of the Monge-Ampere form) has two independent intermediate integrals it is reducible to the form $s=0$ by contact transformations

Very little comparatively has been done for equations of order higher than the second Prof Lloyd Tanner is one of the few pioneers in this region, and his results obtained by a different method are explained in chapter xxii

Prof Forsyth explains in his preface and final remarks the principles which have guided him in his choice of material This must indeed have been a most difficult task It would be easy to dub this treatise encyclopædic but it is not and the fact that it is not is one of its merits The literature on ordinary linear equations alone which has been published since Fuchs's memoir appeared in *Crelle's Journal* would much more than fill the whole of Prof Forsyth's pages No one who is not prepared to devote the whole of his time to the subject can possibly become familiar with all that has been written about it, and even if as is quite possible, this treatise may occasionally disappoint those who consult it on some subsection of the subject in which they are specially interested it is sure to be of great service by presenting an ordered and not unwieldy body of doctrine together with suggestions of the directions in which further progress may be expected.

G B M